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For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

20 SPACECRAFT PROPULSION AND POWER 893

Includes main propulsion systems and components, e.g. rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; propellants and fuels; and materials processing.

23 CHEMISTRY AND MATERIALS (GENERAL) 895

24 COMPOSITE MATERIALS 895

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

For ceramic materials see *27 Nonmetallic Materials.*

25 INORGANIC AND PHYSICAL CHEMISTRY 900

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*

26 METALLIC MATERIALS 903

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

27 NONMETALLIC MATERIALS 906

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials.*

28 PROPELLANTS AND FUELS 910

Includes rocket propellants, igniters and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

29 MATERIALS PROCESSING 910

Includes space-based development of products and processes for commercial application.

For biological materials see *55 Space Biology.*

ENGINEERING

Includes engineering (general); communications and radar; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

For related information see also *Physics.*

31 ENGINEERING (GENERAL) 911

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

32 COMMUNICATIONS AND RADAR 916

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

33 ELECTRONICS AND ELECTRICAL ENGINEERING 921

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

34 FLUID MECHANICS AND HEAT TRANSFER 923

Includes boundary layers; hydrodynamics; fluidics; mass transfer and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

35 INSTRUMENTATION AND PHOTOGRAPHY 928

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation* and *19 Spacecraft Instrumentation.*

36 LASERS AND MASERS 931

Includes parametric amplifiers.

For related information see also *76 Solid-State Physics.*

37 MECHANICAL ENGINEERING 933

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

38 QUALITY ASSURANCE AND RELIABILITY 937

Includes product sampling procedures and techniques; and quality control.

39 STRUCTURAL MECHANICS 937

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

GEOSCIENCES

Includes geosciences (general); earth resources and remote sensing; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

For related information see also *Space Sciences.*

42 GEOSCIENCES (GENERAL) **N.A.**

43 EARTH RESOURCES AND REMOTE SENSING **941**

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

44 ENERGY PRODUCTION AND CONVERSION **943**

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

45 ENVIRONMENT POLLUTION **944**

Includes atmospheric, noise, thermal, and water pollution.

46 GEOPHYSICS **946**

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

47 METEOROLOGY AND CLIMATOLOGY **949**

Includes weather forecasting and modification.

48 OCEANOGRAPHY **951**

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

LIFE SCIENCES

Includes life sciences (general); aerospace medicine; behavioral sciences; man/system technology and life support; and space biology.

51 LIFE SCIENCES (GENERAL) **952**

52 AEROSPACE MEDICINE **953**

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

53 BEHAVIORAL SCIENCES **955**

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT **958**

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

55 SPACE BIOLOGY **N.A.**

Includes exobiology; planetary biology; and extraterrestrial life.

MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL) **959**

60 COMPUTER OPERATIONS AND HARDWARE **960**

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

61 COMPUTER PROGRAMMING AND SOFTWARE **961**

Includes computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM.

62 COMPUTER SYSTEMS **977**

Includes computer networks and special application computer systems.

63 CYBERNETICS **979**

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

64 NUMERICAL ANALYSIS **982**

Includes iteration, difference equations, and numerical approximation.

65 STATISTICS AND PROBABILITY **985**

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

66 SYSTEMS ANALYSIS **N.A.**

Includes mathematical modeling; network analysis; and operations research.

67 THEORETICAL MATHEMATICS **N.A.**

Includes topology and number theory.

PHYSICS

Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy physics; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.

For related information see also *Engineering.*

70 PHYSICS (GENERAL) **986**

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

71 ACOUSTICS 986
Includes sound generation, transmission, and attenuation.
For noise pollution see *45 Environment Pollution.*

72 ATOMIC AND MOLECULAR PHYSICS 987
Includes atomic structure, electron properties, and molecular spectra.

73 NUCLEAR AND HIGH-ENERGY PHYSICS N.A.
Includes elementary and nuclear particles; and reactor theory.
For space radiation see *93 Space Radiation.*

74 OPTICS 988
Includes light phenomena and optical devices.
For lasers see *36 Lasers and Masers.*

75 PLASMA PHYSICS 990
Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics.* For space plasmas see *90 Astrophysics.*

76 SOLID-STATE PHYSICS 994
Includes superconductivity.
For related information see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

77 THERMODYNAMICS AND STATISTICAL PHYSICS 1001
Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.
For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law, political science, and space policy; and urban technology and transportation.

80 SOCIAL SCIENCES (GENERAL) N.A.
Includes educational matters.

81 ADMINISTRATION AND MANAGEMENT 1001
Includes management planning and research.

82 DOCUMENTATION AND INFORMATION SCIENCE 1003
Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.
For computer documentation see *61 Computer Programming and Software.*

83 ECONOMICS AND COST ANALYSIS N.A.
Includes cost effectiveness studies.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY N.A.
Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION N.A.
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences.*

88 SPACE SCIENCES (GENERAL) 1006

89 ASTRONOMY 1008
Includes radio, gamma-ray, and infrared astronomy; and astrometry.

90 ASTROPHYSICS 1012
Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics.*

91 LUNAR AND PLANETARY EXPLORATION 1014
Includes planetology; and manned and unmanned flights.
For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

92 SOLAR PHYSICS 1016
Includes solar activity, solar flares, solar radiation and sunspots.
For related information see *93 Space Radiation.*

93 SPACE RADIATION 1022
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

GENERAL

Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs.

99 GENERAL 1022

Note: N.A. means that no abstracts were assigned to this category for this issue.

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TYPICAL CITATION AND ABSTRACT

NASA SPONSORED
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ACCESSION NUMBER
N89-11793*# . Draper (Charles Stark) Lab., Inc., Cambridge, Mass.
CORPORATE SOURCE
TITLE
CONTROL OF FLEXIBLE STRUCTURES-2 (COFS-2) FLIGHT CONTROL, STRUCTURE AND GIMBAL SYSTEM INTERACTION STUDY Final Report
AUTHORS
Stanley Fay, Stephen Gates, Timothy Henderson, Lester Sackett, Kim Kirchwey, Isaac Stoddard, and Joel Storch Sep. 1988
PUBLICATION DATE
205 p .
CONTRACT OR GRANT
(Contract NAS9-17560)
REPORT NUMBERS
(NASA-CR-172095; R-2088; NAS 1.26:172095) Avail: NTIS HC
AVAILABILITY SOURCE
PRICE CODE
A10/MF A01 CSCL 22B
COSATI CODE
The second Control Of Flexible Structures Flight Experiment (COFS-2) includes a long mast as in the first flight experiment, but with the Langley 15-m hoop column antenna attached via a gimbal system to the top of the mast. The mast is to be mounted in the Space Shuttle cargo bay. The servo-driven gimbal system could be used to point the antenna relative to the mast. The dynamic interaction of the Shuttle Orbiter/COFS-2 system with the Orbiter on-orbit Flight Control System (FCS) and the gimbal pointing control system has been studied using analysis and simulation. The Orbiter pointing requirements have been assessed for their impact on allowable free drift time for COFS experiments. Three fixed antenna configurations were investigated. Also simulated was Orbiter attitude control behavior with active vernier jets during antenna slewing. The effect of experiment mast dampers was included. Control system stability and performance and loads on various portions of the COFS-2 structure were investigated. The study indicates possible undesirable interaction between the Orbiter FCS and the flexible, articulated COFS-2 mast/antenna system, even when restricted to vernier reaction jets. Author

VOLUME 27 NUMBER 7 / APRIL 8, 1989

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERONAUTICS (GENERAL)

N89-15071# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
LA RECHERCHE AEROSPATIALE, BIMONTHLY BULLETIN, NUMBER 1988-1, 242/JANUARY-FEBRUARY
ESA Sep. 1988 71 p Transl. into ENGLISH of La Recherche Aerospatiale, Bulletin Bimestriel (Paris, France, ONERA), no. 1988-1, 242/Jan.-Feb.
(ESA-TT-1133; ETN-89-93636) Avail: NTIS HC A04/MF A01

Flame stabilization in supersonic combustion; numerical analysis of vortex breakdowns under pressure gradients; an antistatic coating tester; dimensioning of turbine blades for fatigue and creep; computation of stress singularities in edge effects of multilayer composites; and chaotic motions, strange attractors, and stability are discussed. ESA

N89-15072*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ON THE INSTABILITY OF HYPERSONIC FLOW PAST A WEDGE Final Report
Stephen Cowley and Philip Hall (Exeter Univ., England) Dec. 1988 45 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-181760; ICASE-88-72; NAS 1.26:181760) Avail: NTIS HC A03/MF A01 CSCL 01B

The instability of a compressible flow past a wedge is investigated in the hypersonic limit. Particular attention is given to the Tollmien-Schlichting waves governed by triple-deck theory though some discussion of inviscid modes is given. It is shown that the attached shock has a significant effect on the growth rates of Tollmien-Schlichting waves. Moreover, the presence of the shock allows for more than one unstable Tollmien-Schlichting wave. Indeed, an infinite discrete spectrum of unstable waves is induced by the shock, but these modes are unstable over relatively small but high frequency ranges. The shock is shown to have little effect on the inviscid modes considered by previous authors and an asymptotic description of inviscid modes in the hypersonic limit is given. Author

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N89-15073*# Nevada Univ., Reno. Engineering Research and Development Center.
NUMERICAL INVESTIGATIONS IN THREE-DIMENSIONAL INTERNAL FLOWS Semiannual Status Report, 1 Apr. - 30 Sep. 1988
William C. Rose 22 Nov. 1988 26 p
(Contract NCC2-507)
(NASA-CR-183395; NAS 1.26:183395) Avail: NTIS HC A03/MF A01 CSCL 01A

Renewed interest in simulation of high enthalpy flows was brought about by interest in the design and testing of hypersonic propulsion components. This renewed interest has led to refurbishment of high speed ground based wind tunnel facilities. Simulation of the high enthalpy flows occurring in the NASP propulsion system is of particular interest. Studying the combustor presentes some of the more challenging problems in the ground based simulation of the fluid flow. A difficulty in simulating the required conditions at the entrance to the combustor is related to achieveing a sufficiently high static pressure such that combustion would be possible at a high Mach number. An analysis of the flow within the original nozzle was not performed previously using numerical simulations, although it was operated experimentally. A Navier-Stokes code was chosen in the present study to examine analytically the flow within representative selected nozzles for use in combustion experiments. The numerical simulation of these fluid flows is popular and may be able to shed light on the direction that redesign of the shock tube nozzles should take. The numerical codes were modified to account for the axially symmetric flow field, for the inclusion of equilibrium real gas effects and for ideal gases whose thermodynamic properties are frozen at the stagnation conditions. Numerical simulation of flows within the original and two proposed nozzles, including the energy lost to the relatively cold walls, are investigated. Author

N89-15074*# San Jose State Univ., CA. Dept. of Mechanical Engineering.
AERODYNAMIC MANEUVERING HYPERSONIC FLIGHT MECHANICS Final Report, 1 Jun. 1987 - 30 Sep. 1988
Dick Desautel 4 Nov. 1988 18 p
(Grant NAG2-457)
(NASA-CR-183007; NAS 1.26:183007) Avail: NTIS HC A03/MF A01 CSCL 01A

The emergence of current high-interest mission involving aeromaneuvering hypersonic flight has given rise to the corresponding need for preliminary design and performance analyses of such vehicles. This need in turn has motivated efforts to develop simplified analytical and computational methods for parametric analysis of maneuvering hypersonic flight under conditions appropriate to the mission involved. The effort included a review of different formulations of the general equations of motion, their associated coordinate frames, various simplifications of the equations, and previously achieved analytical solutions. This study sought to both extend previous solution methods and to develop new ones. In addition, evaluation of the literature and developing a systematic perspective on the knowledge it represents proved to be a major portion of the effort. Author

N89-15075 Leicester Univ. (England).
AERODYNAMIC DRAG OF RIDGE ARRAYS IN ADVERSE PRESSURE GRADIENTS Ph.D. Thesis
M. F. Abd Rabbo 1976 234 p
Avail: Univ. Microfilms Order No. BRD-82088

Drag measurements for excrescence arrays of square section mounted on a smooth wall and subject to two adverse pressure gradients in equilibrium are obtained. Differences in drag which arise when the excrescence are uniformly distributed and when tending to isolation are shown. Flow visualization photographs using the surface oil flow technique are presented to illustrate different flow patterns around arrays of varying spacing. A prediction model

for the drag of excrescence arrays based on the results obtained was devised. Its range of application could be extended to excrescences of varying shape providing they are sufficiently small to be immersed in the logarithmic part of the boundary layer. Drag results are determined by both a momentum defect and a pressure distribution technique. These results are compared and the difference between them is partially attributed to the change in the surface friction between the excrescence and partially to some lack of two-dimensionality in the test procedures. Corrections for the latter effect are made to the data obtained.
Dissert. Abstr.

N89-15076# Naval Underwater Systems Center, New London, CT. Launcher and Missile Systems Dept.
AERODYNAMIC DRAG OF CYLINDRICAL VEHICLES MOVING CONCENTRICALLY WITHIN LONG TUBES
D. A. Kotlow 9 Mar. 1988 128 p
(AD-A197947; NUSC-TR-6638) Avail: NTIS HC A07/MF A01 CSCL 20D

A numerical analysis is made of developing and developed turbulent flow in the annular region between a cylinder moving at constant velocity within a fixed concentric tube. Turbulent shear is modeled by eddy viscosity, and a uniform velocity is assumed at the entrance to the annular region. The computations extend and modify the method of Sud and Chaddock (1981) to arbitrary Reynolds numbers and radius ratios. While this report is based on the author's masters thesis, the fully developed flow results are more complete, and those for developing flow are more accurate. Better accuracy was achieved by implementing double precision, which enabled the computations to be performed further into the developing region. GRA

N89-15077*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
APPLICATION OF A LOWER-UPPER IMPLICIT SCHEME AND AN INTERACTIVE GRID GENERATION FOR TURBOMACHINERY FLOW FIELD SIMULATIONS
Yung K. Choo, Woo-Yung Soh, and Seokkwan Yoon (MCAT Inst., Moffett Field, CA.) 1989 17 p Proposed for presentation at the 34th International Gas Turbine and Aeroengine Congress and Exposition, Toronto, Ontario, 4-8 Jun. 1989; sponsored by the American Society of Mechanical Engineers
(NASA-TM-101412; E-4374; NAS 1.15:101412) Avail: NTIS HC A03/MF A01 CSCL 01A

A finite-volume lower-upper (LU) implicit scheme is used to simulate an inviscid flow in a tubine cascade. This approximate factorization scheme requires only the inversion of sparse lower and upper triangular matrices, which can be done efficiently without extensive storage. As an implicit scheme it allows a large time step to reach the steady state. An interactive grid generation program (TURBO), which is being developed, is used to generate grids. This program uses the control point form of algebraic grid generation which uses a sparse collection of control points from which the shape and position of coordinate curves can be adjusted. A distinct advantage of TURBO compared with other grid generation programs is that it allows the easy change of local mesh structure without affecting the grid outside the domain of independence. Sample grids are generated by TURBO for a compressor rotor blade and a turbine cascade. The turbine cascade flow is simulated by using the LU implicit scheme on the grid generated by TURBO. Author

N89-15078*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
HOT GAS INGESTION TESTING OF AN ADVANCED STOVL CONCEPT IN THE NASA LEWIS 9- BY 15-FOOT LOW SPEED WIND TUNNEL WITH FLOW VISUALIZATION
Albert L. Johns, Joseph D. Flood, Thomas W. Strock, and Kurt C. Amuedo (McDonnell-Douglas Corp., St. Louis, MO.) [1988] 27 p Presented at the 24th Joint Propulsion Conference, Boston, MA, 11-13 Jul. 1988; sponsored by AIAA, ASME, SAE and ASEE
(NASA-TM-100952; E-4250; NAS 1.15:100952; AIAA-88-3025) Avail: NTIS HC A03/MF A01 CSCL 01A

Advanced Short Takeoff/Vertical Landing (STOVL) aircraft capable of operating from remote sites, damaged runways, and small air capable ships are being pursued for deployment around the turn of the century. To achieve this goal, it is important that the technologies critical to this unique class of aircraft be developed. Recognizing this need, NASA Lewis Research Center, McDonnell Douglas Aircraft, and DARPA defined a cooperative program for testing in the NASA Lewis 9- by 15-Foot Low Speed Wind Tunnel (LSWT) to establish a database for hot gas ingestion, one of the technologies critical to STOVL. Results from a test program are presented along with a discussion of the facility modifications allowing this type of testing at model scale. These modifications to the tunnel include a novel ground plane, an elaborate model support which included 4 degrees of freedom, heated high pressure air for nozzle flow, a suction system exhaust for inlet flow, and tunnel sidewall modifications. Several flow visualization techniques were employed including water mist in the nozzle flows and tufts on the ground plane. Headwind (free-stream) velocity was varied from 8 to 23 knots. Author

N89-15079# Tennessee Univ. Space Inst., Tullahoma. Gasdynamics Div.
INVESTIGATION OF PHENOMENA OF DISCRETE WINGTIP JETS Final Technical Report, May 1986 - Aug. 1988
J. M. Wu, A. D. Vakili, Z. Shi, and J. D. Mo Aug. 1988 60 p
(Grant AF-AFOSR-0155-86; AF Proj. 2307)
(AD-A199962; UTSI-88-06; AFOSR-88-0937TR) Avail: NTIS HC A04/MF A01 CSCL 20D

Detail flow phenomena of discrete wingtip jets blowing from a rectangular wing with squared edges and round tips are investigated in the water-and wind-tunnel experiments. Phenomena on a single asymmetric jet blowing from a flat-plate in crossflow were incorporated into the present wingtip jet study. The local flow field perturbation introduced by the tip jet blowing closely resembles that of the asymmetric jet from the flat-plate. The wingtip jet has influenced the global surface pressure distribution over the wing and improved the lift loading. A simple mathematical model is developed for practical calculation of wing loading. GRA

N89-15080# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, OH.
HEAT TRANSFER RATES ON AN ANALYTIC FOREBODY IN THE AFWAL (AIR FORCE WRIGHT AERONAUTICAL LABORATORIES) MACH 3 HIGH REYNOLDS NUMBER WIND TUNNEL. COMPARISON OF TEST RESULTS WITH PREDICTIONS FROM STAPAT (A SPECIFIC THERMAL ANALYZER PROGRAM FOR AIRCRAFT TRANSPARENCIES) Final Report, Oct. 1984 - Sep. 1986
Charles A. Babish, III and James R. Hayes 22 Apr. 1988 112 p
(AD-A199523; AFWAL-TR-87-3091) Avail: NTIS HC A06/MF A01 CSCL 01A

This report describes a wind tunnel test program and the STAPAT computer program which were used to study heat transfer rates on an analytic forebody at Mach 3.0. STAPAT, a Specific Thermal Analyzer Program for Aircraft Transparencies, defines aerodynamic heating environments over windshields and canopies of high speed aircraft. STAPAT predictions were compared with measurements on an analytic forebody whose shape is representative of the forward fuselage of an aircraft. The measurements were obtained using a newly developed experimental technique for determining heat transfer rates at high Reynolds numbers and supersonic speeds in a cold flow wind tunnel. This technique incorporated a means for raising the temperature of the outer surface of the analytic forebody above the recovery temperature of the tunnel which was operated at stagnation temperatures near atmospheric. Heat transfer rates were significantly influenced by tunnel stagnation temperatures, gage surface temperatures and water temperatures. Use of a nondimensional heat transfer coefficient, the Stanton number, effectively eliminated heat transfer rate dependency upon these temperatures and therefore was shown to be the best way to evaluate heat transfer rates over the analytic forebody. The

magnitudes of the measured heat transfer rates, their distribution over the analytic forebody and their good agreement with STAPAT calculations. GRA

N89-15081# Aeronautical Research Labs., Melbourne (Australia).
A GUIDE TO INPUT AND OUTPUT FOR THE VORSBA COMPUTER PROGRAM
L. D. MacLaren Jul. 1988 51 p
(AD-A199560; ARL-AERO-TM-398; DODA-AR-005-535) Avail: NTIS HC A04/MF A01 CSCL 12E

The VORSBA computer program is used to calculate the incompressible vortex flow about slender wing configurations. Three programs have been written to enable the user (especially the beginner) to run VORSBA more efficiently. These include an input preprocessor, an output file handling program and a graphical output routine. A comprehensive set of examples is also given which can be used as a basic solution for many problems that are likely to be encountered. GRA

N89-15082*# Stanford Univ., CA. Dept. of Aeronautics and Astronautics.
SHOCK TUBE INVESTIGATION OF DYNAMIC RESPONSE OF PRESSURE TRANSDUCERS FOR VALIDATION OF ROTOR PERFORMANCE MEASUREMENTS
Daniel Bershader Dec. 1988 31 p
(Contract NCC2-549)
(NASA-CR-182673; NAS 1.26:182673; SU-Aero-48-88) Avail: NTIS HC A03/MF A01 CSCL 01A

For some time now, NASA has had a program under way to aid in the validation of rotor performance and acoustics codes associated with the UH-60 rotary-wing aircraft; and to correlate results of such studies with those obtained from investigations of other selected aircraft rotor performance. A central feature of these studies concerns the dynamic measurement of surface pressure at various locations up to frequencies of 25 KHz. For this purpose, fast-response gauges of the Kulite type are employed. The latter need to be buried in the rotor; they record surface pressures which are transmitted by a pipette connected to the gauge. The other end of the pipette is cut flush with the surface. In certain locations, the pipette configuration includes a rather sharp right-angle bend. The natural question has arisen in this connection: In what way are the pipettes modifying the signals received at the rotor surface and subsequently transmitted to the sensitive Kulite transducer element. The basic details and results of the program performed and recently completed in the High Pressure Shock Tube Laboratory of the Department of Aeronautics and Astronautics at Stanford University are given. Author

N89-15083# European Space Agency, Paris (France).
EXPERIMENTAL INVESTIGATION OF PROPAGATION OF SHOCKWAVE INDUCED DISTURBANCES IN TRANSONIC AIRFOILS
Dieter Basler (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen, Germany, F.R.) Sep. 1988 139 p Transl. into ENGLISH of Experimentelle Untersuchung der Ausbreitung Stossinduzierter Stoerungen an Transsonischen Profilen (Goettingen, Fed. Republic of Germany, DFVLR) Jul. 1987 128 p Original language document was announced as N88-16666
(ESA-TT-1097; DFVLR-FB-87-28; ETN-89-93634) Avail: NTIS HC A07/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 38 Deutsche marks

The mechanism of buffeting was investigated in a wind tunnel on a transonic airfoil. A holographic high speed real time interferometer was developed to observe and analyze the entire flow field surrounding the airfoil. The information from interferograms was compared with results from hot film and pressure measurements. The results show that the shock oscillation can be described by an interaction of the shock with the boundary layer and the flow conditions at the trailing edge of the airfoil. The observed buffet frequencies are higher for an initially laminar boundary layer than for a turbulent boundary layer. Buffet frequency decreases with increasing Reynolds number in the case of a turbulent boundary layer. ESA

N89-15084*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
AN EXPERIMENTAL INVESTIGATION OF MULTI-ELEMENT AIRFOIL ICE ACCRETION AND RESULTING PERFORMANCE DEGRADATION
Mark G. Potapczuk and Brian M. Berkowitz (Sverdrup Technology, Inc., Cleveland, OH.) 1989 40 p Presented at the 27th Aerospace Sciences Meeting, Reno, NV, 9-12 Jan. 1989; sponsored by AIAA
(NASA-TM-101441; E-4546; NAS 1.15:101441; AIAA-89-0752)
Avail: NTIS HC A03/MF A01 CSCL 01A

An investigation of the ice accretion pattern and performance characteristics of a multi-element airfoil was undertaken in the NASA Lewis 6- by 9-Foot Icing Research Tunnel. Several configurations of main airfoil, slat, and flaps were employed to examine the effects of ice accretion and provide further experimental information for code validation purposes. The test matrix consisted of glaze, rime, and mixed icing conditions. Airflow and icing cloud conditions were set to correspond to those typical of the operating environment anticipated tor a commercial transport vehicle. Results obtained included ice profile tracings, photographs of the ice accretions, and force balance measurements obtained both during the accretion process and in a post-accretion evaluation over a range of angles of attack. The tracings and photographs indicated significant accretions on the slat leading edge, in gaps between slat or flaps and the main wing, on the flap leading-edge surfaces, and on flap lower surfaces. Force measurments indicate the possibility of severe performance degradation, especially near C sub Lmax, for both light and heavy ice accretion and performance analysis codes presently in use. The LEWICE code was used to evaluate the ice accretion shape developed during one of the rime ice tests. The actual ice shape was then evaluated, using a Navier-Strokes code, for changes in performance characteristics. These predicted results were compared to the measured results and indicate very good agreement. Author

N89-15085*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
NONLINEAR INTERACTION OF NEAR-PLANAR TS WAVES AND LONGITUDINAL VORTICES IN BOUNDARY-LAYER TRANSITION Final Report
F. T. Smith Nov. 1988 37 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-181751; ICASE-88-66; NAS 1.26:181751) Avail: NTIS HC A03/MF A01 CSCL 01A

The nonlinear interactions that evolve between a planar or nearly planar Tollmien-Schlichting (TS) wave and the associated longitudinal vortices are considered theoreticaliy for a boundary layer at high Reynolds number. The vortex flow is either induced by the TS nonlinear forcing or is input upstream, and similarly for the nonlinear wave development. Three major kinds of nonlinear spatial evolution, Types 1-3, are found. Each can start from secondary instability and then become nonlinear, Type 1 proving to be relatively benign but able to act as a pre-cursor to the Types 2, 3 which turn out to be very powerful nonlinear interactions. Type 2 involves faster stream-wise dependence and leads to a finite-distance blow-up in the amplitudes, which then triggers the full nonlinear 3-D triple-deck response, thus entirely altering the mean-flow profile locally. In contrast, Type 3 involves slower streamwise dependence but a faster spanwise response, with a small TS amplitude thereby causing an enhanced vortex effect which, again, is substantial enough to entirely alter the meanflow profile, on a more global scale. Streak-like formations in which there is localized concentration of streamwise vorticity and/or wave amplitude can appear, and certain of the nonlinear features also suggest by-pass processes for transition and significant changes in the flow structure downstream. The powerful nonlinear 3-D interactions 2, 3 are potentially very relevant to experimental findings in transition. Author

N89-15086*# Washington Univ., Seattle. Dept. of Aeronautics and Astronautics.
AERODYNAMICS OF VORTEX GENERATORS Final Report, Jan. 1984 - Dec. 1987
Robert E. Breidenthal, Jr. and David A. Russell [1988] 7 p
(Grant NAG2-283)
(NASA-CR-182511; NAS 1.26:182511) Avail: NTIS HC A02/MF A01 CSCL 01A

An experimental and theoretical study was undertaken of the separation delay and dramatic boundary-layer thinning that can occur in vortex-generator installations. Wind tunnel measurements of the dynamic-pressure profile downstream of a vortex generator were found to compare under certain conditions with that downstream of a suction slit, while water-tunnel visualization studies of vortex-generator height and geometry suggested optimum configurations, and only a minor effect of base porosity. A series of progressively more complex inviscid flow models was developed to be applied to a 3-D integral boundary-layer code. This code predicted layer thinning downstream of the suction site of the vortex models, and other observed features. Thin-layer Navier-Stokes equations are now being used with the ultimate goal of clarifying the physical processes involved in vortex generator performance and developing calculational procedures capable of predicting it. Author

N89-15087*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
FLUTTER ANALYSIS OF HIGHLY SWEPT DELTA WINGS BY CONVENTIONAL METHODS
M. D. Gibbons, D. L. Soistmann (PRC Systems Services Co., Hampton, VA.), and R. M. Bennett Nov. 1988 20 p
(NASA-TM-101530; NAS 1.15:101530) Avail: NTIS HC A03/MF A01 CSCL 01A

The flutter boundaries of six thin highly-swept delta-platform wings have been calculated. Comparisons are made between experimental data and results using several aerodynamic methods. The aerodynamic methods used include a subsonic and supersonic kernel function, second order piston theory, and a transonic small disturbance code. The dynamic equations of motion are solved using analytically calculated mode shapes and frequencies. Author

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N89-15088# Boeing Advanced Systems Co., Seattle, WA.
ADVANCED AIR SEPARATION MODULE PERFORMANCE EVALUATION Final Report, May 1986 - Sep. 1987
Charles L. Anderson Jul. 1988 215 p
(Contract F33615-84-C-2431)
(AD-A198401; D180-30946-1; AFWAL-TR-88-2031) Avail: NTIS HC A10/MF A01 CSCL 21D

Results of an experimental performance evaluation of two advanced lightweight permeable membrane (PM) air space modules (ASM) are presented. ASMs produce nitrogen enriched air which is used for airplane fuel tank inerting. The airplane inerting system is termed On-Board Inert Gas Generator System (OBIGGS). ASMs were obtained from two sources: A/G Technology Corp. and Permea Inc. Steady state performance envelope, long term endurance, hot/cold start-up on/off cycling, moisture, vibration, contaminant, and high temperature destructive tests were conducted. Results indicate that a significant breakthrough in OBIGGS weight reduction has been achieved. Both the A/G and Permea ASMs offer significant reductions in weight over present SOTA (state-of-the-art) ASM technology. Performance of the A/G and Permea ASMs is directly compared to other ASM technology in terms of ASM weight as well as total airplane penalties which include bleed air usage and bleed system component weight. Comparisons indicate that the advanced ASMs will allow significant weight reductions in the bleed air system compared to present SOTA ASM technology. This was accomplished by using less bleed air at higher temperatures. Basic ASM performance models are presented along with analysis of ASM moisture sensitivity, pressure drop, and thermal response. GRA

N89-15089# Federal Aviation Administration, Washington, DC.
AIRPORT ACTIVITY STATISTICS OF CERTIFICATED ROUTE AIR CARRIERS
31 Dec. 1987 930 p
(AD-A199186) Avail: NTIS HC A99/MF A02 CSCL 01E

This report furnishes airport activity of the large Certificated Route Air Carriers. Included in the data contained in Table 6 are passenger enplanements, tons of enplaned freight, express, and mail. Both scheduled and non-scheduled service, and domestic and international operations are included. These data are shown by airport and carrier. Table 7 includes departure by airport, carrier and type of operation, and type of aircraft. GRA

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *Communications and Radar.*

N89-15090# Defence Research Establishment Ottawa, (Ontario). Electronics Div.
TESTING AND USE OF THE MAGNAVOX MANPACK GPS (GLOBAL POSITIONING SYSTEM) USER EQUIPMENT
Michael Vinnins and Rene Apps 30 Jun. 1988 20 p
(AD-A199893; DREO-TN-88-17) Avail: NTIS HC A03/MF A01 CSCL 17G

Since June 1985, Canada has employed the Magnavox GPS Manpack receivers in support of several programs. Primarily the set was used as a reference system during tests of the Primary Land Arctic Navigation System (PLANS) on board an M117 armoured personnel carrier during field trials at CFB Petawawa in Nov. 1985 and Sept. 1986. The set was also employed in the same capacity during sea trials of the Marine Integrated Navigation System (MINS) off the west coast of Vancouver Island during Nov. 1986. During the sea trial, reference data was also being recorded from a Syledis shore-based reference system (2 to 5 meter accuracy). GPS Manpack data was compared to the Syledis data and results are contained in the report. GRA

N89-15091# Oklahoma State Univ., Stillwater. Electronics Research and Development Lab.
GLOBAL POSITIONING SYSTEM ADAPTATION FOR BALLOON PAYLOADS
Randall D. Donahoo 7 May 1988 51 p
(Contract F19628-85-C-0006)
(AD-A199997; AFGL-TR-88-0096; SR-4) Avail: NTIS HC A04/MF A01 CSCL 17G

A reliable method of using the GPS for tracking AFGL balloon payloads has been developed. The system uses the Collins-Rockwell Navcore I GPS receiver and data converter along with some custom designed signal conditioning electronics. The airborne package consists of a Navcore I receiver, a data converter and a proper signal conditioning to provide the modulation signal to an S-band telemetry transmitter. This transmitter is to be used for transmission of both the payload's telemetry data and GPS receiver's navigation solution. Two methods (PCM/FM and FM/FM) of transmitting the GPS data along with the telemetry data are presented. The ground station equipment consists of an S-band receiver, FM discriminator if required, signal conditioning electronics, and an IBM PC compatible computer. The computer

provides real-time display and recording of the GPS receiver's position (latitude, longitude, and altitude). Other payload statuses provided are: GPS second of week, speed, heading, and vertical velocity. The recorded GPS data -- on the PC's hard disk -- is available for any necessary post-flight processing. Two formats of post-processed information are created, tabular and plotted. Tabular listings are created for flight review. Plots generated from the tabular listings by using a spreadsheet with graphic display routines can be inspected to determine if possible correlations exist between any two parameters. GRA

N89-15092# Federal Aviation Agency, Atlantic City, NJ.
HELIPORT VISUAL APPROACH SURFACE HIGH TEMPERATURE AND HIGH ALTITUDE TEST PLAN Technical Note, Oct. - Dec. 1987
Marvin S. Plotka and Rosanne M. Weiss Jun. 1988 28 p
(AD-A200027; DOT/FAA/CT-TN88/5) Avail: NTIS HC A03/MF A01 CSCL 01C

The purpose of this test plan on Helicopter Visual Meteorological Conditions (VMC) Clearance project to be conducted at high temperature and high altitude conditions are as follows: (1) The identification of problems to be investigated; (2) The definition of the tasks required to resolve these problems; (3) The development of test procedures; (4) The description of the methodology for data collection, reduction, and analysis; (5) The specification of the required data. The focus of this test is on the issue of airspace requirement and obstruction protection requirements for visual approaches and departures at a heliport. GRA

N89-15093# Federal Aviation Agency, Atlantic City, NJ.
HELIPORT VISUAL APPROACH AND DEPARTURE AIRSPACE TESTS. VOLUME 1: SUMMARY Technical Note, Mar. - Jul. 1987
Rosanne M. Weiss, Christopher J. Wolf, Maureen Harris, and James Triantos Aug. 1988 39 p
(AD-A200028; DOT/FAA/CT-TN87/40-1) Avail: NTIS HC A03/MF A01 CSCL 01C

During the winter and spring of 1987 flight tests were conducted at the FAA's Technical Center's Concepts Development and Demonstration Heliport at the Atlantic City International Airport, N.J. The purpose of these flights was to examine and validate the current heliport approach/departure surfaces criteria as defined in the heliport Design Guide and to recommend modifications to these surfaces, if appropriate. The flight activities were conducted using aircraft representative of those in the civilian world. Data were collected using approach surfaces of 7.125, 8.00, and 10.00 deg for straight as well as curved path procedures. Also, departure surfaces of 7.125, 10.00, and 12.00 deg for straight and curved path procedures were used. All maneuvers were tracked by ground based tracking systems. This report documents the results of this activity. It describes the flight test and evaluation methodology and addresses technical as well as operational issues. It provides statistical and graphical analysis of pilot performance along with a discussion of pilot subjective opinions concerning the acceptability and perceived workload, safety, and control margins associated with the procedures flown. The results of this work will be considered in the future modifications of the FAA Heliport Design Advisory Circular, AC 150/5390-2. GRA

N89-15094# Environmental Research Inst. of Michigan, Ann Arbor.
COMPUTER SIMULATION OF ANIMAL NAVIGATION Annual Technical Report, Jul. 1986 - Aug. 1987
Kristina VanVoorhis and Robert F. Franklin Jul. 1988 19 p
(Contract DAAE07-86-C-R013; ARPA Order 5575)
(AD-A199376; ERIM-196000-6-T) Avail: NTIS HC A03/MF A01 CSCL 17G

The robotics research community is striving to endow a wide variety of vehicles with the capability of autonomous mobility. Related research is being undertaken in two intrinsically different test vehicles. The ASV (Adaptive Suspension Vehicle), which uses legs as a means of propulsion, is being utilized to address problems of mobility. Mobility research is concerned with the problem of traveling over terrains of high spatial complexity. Machine autonomy can be defined as the ability of a machine to perform tasks in an arbitrarily complex and dynamic environment without external assistance during operation. Autonomy is a subject of research in the wheeled ALV (Autonomous Land Vehicle) program. By endowing the ASV with a decision system for autonomous navigation over rough terrain, both efforts can be concentrated in one test-bed. Research on foothold selection during terrain traversal was conducted through studies of natural systems and computer simulation. Experiments were performed with Nubian goats on simulated rough terrain in order to explore the ways in which natural systems select footholds. A computer simulation of rough terrain traversal was developed in parallel with the animal studies. Pertinent results from the animal experiments were integrated into the computer simulation. GRA

N89-15095# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Abteilung Systemtechnik und Navigation.
THE DATA SYSTEM ON BOARD THE DO 228 FOR TESTING NAVIGATION SYSTEMS WITH HIGH ACCURACY
Hans-Peter Zenz May 1988 73 p In GERMAN; ENGLISH summary
(DFVLR-Mitt-88-20; ISSN-0176-7739; ETN-89-93660) Avail: NTIS HC A04/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 29 Deutsche marks

The measuring systems (MUDAS) on the test aircraft DO 228, part of an avionics flight evaluation system for testing navigation systems, are described. A digital navigation computer on the aircraft calculates the position and velocity with high accuracy based on the data of an inertial navigation system (INS), a laser tracker, and a tracking radar. The accuracy of the unaided INS (a laser gyro strapdown navigation system) is described, as well as the time delay of the INS data transmission. Using the INS data, the flight dynamics of the DO 228 were investigated. ESA

N89-15096# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung.
SIMULATION OF A FUTURE TERMINAL MANEUVERING AREA (TMA) SCENARIO
Volkmar Adam, Wilfried Gerling, Karlheinz Hurrass, Elmar Klostermann, and Fred Schick Jun. 1988 50 p
(DFVLR-FB-88-33; ISSN-0171-1342; ETN-89-93757) Avail: NTIS HC A03/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 18 Deutsche marks

Real time air traffic simulations of a terminal maneuvering area scenario were performed. It was assumed that most of the approaching aircraft use 4D-procedures. Different traffic mixes of 4D-/non-4D-aircraft were investigated. Results indicate that the future 4D environment will be based on an improved communication, navigation, and surveillance system of high accuracy which includes data link components. This system may not necessarily work on a satellite basis. Special features of the 4D environment will be a strategic and tactical control concept together with a high degree of automation. These prerequisites provide for the ability to fly idle descent profiles on accurate horizontal tracks. Holdings will be avoided. Separation will not be a critical factor. Landing rate improves. ESA

N89-15097# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.
THE CHALLENGE OF LOWERED VISIBILITY LIMITS FOR PRECISION APPROACH AND LANDING WITH HELICOPTERS
Tj. Hoekstra 26 Jul. 1985 37 p
(NLR-MP-87033-U; ETN-89-93883) Avail: NTIS HC A03/MF A01

It is claimed that the relatively favorable low-speed characteristics of helicopters, compared with fixed-wing aircraft, allow reduced visibility limits, without the need for additional equipment. Aspects related to instrument flight are considered and,

based on the results of tests carried out elsewhere, a proposal for reduced visibility limits is formulated. Simulator tests should be carried out to substantiate the proposed limits of 100 ft decision height and 300 m runway visual range in a low-risk environment before carrying out flight tests. ESA

N89-15098# European Space Agency, Paris (France).
RESULTS OF THE ONE-WAY TRANSIT TIME MEASURING IN NAVIGATION EXPERIMENT NAVEX
Emil Sappl, Herbert Schild, and Anita Zimmermann (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, West Germany) Nov. 1988 37 p Transl. into ENGLISH of Ergebnisse zur Einweglaufzeitmessung beim Navigationsexperiment NAVEX (Oberpfaffenhofen, Fed. Republic of Germany, DFVLR), Aug. 1987 38 p Original language document was announced as N88-21145
(ESA-TT-1110; DFVLR-Mitt-87-17; ETN-89-93907) Avail: NTIS HC A03/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 14 Deutsche marks

The task of one way transit time measurement in Spacelab experiment NAVEX during the D1 mission was to measure distances between the shuttle and the ground stations by measuring the transit time of transmitted signals. A set of results of these measurements is presented. ESA

N89-15099*# McDonnell-Douglas Corp., Long Beach, CA.
SIMULATED FINAL APPROACH PATH CAPTURES USING THE MICROWAVE LANDING SYSTEM Final Report
J. B. Feather Dec. 1988 79 p
(Contract NAS1-18028)
(NASA-CR-181696; NAS 1.26:181696; C1-E42-TN-392) Avail: NTIS HC A05/MF A01 CSCL 17G

Computer simulation results are presented for intercepting final approach paths using various Microwave Landing System (MLS) path capture concepts. This study, conducted under the Advanced Transport Operating System (ATOPS) program, simulated these captures using the MD-80 aircraft as the study model. Several different capture concepts were investigated. Systems that could be retrofitted into existing aircraft with minimum hardware and software changes were considered. An enhanced ILS look-alike capture provided improved tracking performance over conventional ILS without using a full-up path computer. The other concepts used waypoint databases and path computers to provide smart captures. These captures included lateral path intercepts as well as vertical path control. Winds, turbulence, and MLS noise were included in the simulation. In all cases, acceptable tracking errors were obtained during transition to the final approach path. Author

N89-15100# Federal Aviation Agency, Atlantic City, NJ.
CONTROLLER EVALUATION OF INITIAL DATA LINK AIR TRAFFIC CONTROL SERVICES: MINI STUDY 1, VOLUME 1
Nicholas J. Talotta Sep. 1988 38 p Prepared in cooperation with Mitre Corp., Atlantic City, NJ; and NTI, Inc., Dayton, OH
(Contract T2001B)
(DOT/FAA/CT-88/25-Vol-1) Avail: NTIS HC A03/MF A01

This report gives the results of Ministudy 1, Volume 1. This ministudy was conducted at the FAA Technical Center utilizing the Data Link testbed. Initial Data Link air traffic control services were evaluated under part task simulation conditions in order to identify service delivery methods which optimize controller acceptance, performance and workload. This report delineates the results for the first of two ministudies and a research and development operational evaluation which comprise the Phase 1 Data Link services package. Author

N89-15101# Federal Aviation Agency, Atlantic City, NJ.
CONTROLLER EVALUATION OF INITIAL DATA LINK AIR TRAFFIC CONTROL SERVICES: MINI-STUDY 1, VOLUME 2 Final Report
Nicholas J. Talotta Sep. 1988 120 p
(Contract T2001B)
(DOT/FAA/CT-88/25-Vol-2) Avail: NTIS HC A06/MF A01

This report gives the results of Ministudy 1, Volume 2. This ministudy was conducted at the FAA Technical Center utilizing the Data Link test bed. Initial Data Link air traffice control services were evaluated under part task simulation conditions in order to identify service delivery methods which optimize controller acceptance, performance, and workload. This report delineates the results for the first of two ministudies and a research and development operational evaluation which comprise the Phase 1 Data Link services package. Author

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.* For land transportation vehicles see *85 Urban Technology and Transportation.*

N89-15102 Cranfield Inst. of Tech., Bedford (England).
DEVELOPMENT OF AN AIRCRAFT DESIGN EXPERT SYSTEM Ph.D. Thesis
J. Alsina 1988 212 p
Avail: Univ. Microfilms Order No. BRDX82198

The aircraft design process is characterized by the application of a wide range of knowledge across many disciplines based upon a certain degree of judgment and experience of the designer. A two pass approach was taken towards the development of an aircraft design expert system based on the requirements of two conceptually different design steps namely, wing design and aircraft configuration. The current status of the work is one where an actual program for wing design exists with supporting documentation, and a very effective examination of the knowledge base performed based on the detail investigation of the overall aircraft design process with particular emphasis on the wing design and the aircraft configuration design steps. The approach taken accomplishes the objectives of the current research in defining the knowledge base, providing the tools and specifications for tools to be used within an aircraft design expert system closely following the problem-solving techniques utilized by the design expert. Dissert. Abstr.

N89-15103# Ballistic Research Labs., Aberdeen Proving Ground, MD.
COMPUTER-AIDED TECHNIQUES FOR SURVIVABILITY/LETHALITY MODELING Final Report
Paul H. Deitz Feb. 1988 42 p
(AD-A197893; BRL-MR-3667) Avail: NTIS HC A03/MF A01 CSCL 12E

The vulnerability of a combat system is an assessment of its susceptibility to damage, given a specific encounter with a particular threat. By contrast, system survivability can be taken to be the examination of all performance parameters which affect its availability to perform an assigned mission. Thus survivability subsumes vulnerability with the addition of many other factors. Some of the system parameters contributing to survivability are: Mobility; Agility; NBC Protection; Detection Probabilities; Magnetic; Acoustic; Optical; Infrared; and Centimeter waves/millimeter waves; and Conventional Vulnerability. The theme of this Symposium is, The Total System Approach to Combat Survivability. Such an approach, therefore, requires a broad set of analytic tools which permit a system to be analyzed from many aspects with a consistent set of inputs. The aim of this paper is to describe a high-resolution modeling environment which supports the symposium theme; this environment is being rapidly expanded and is characterized by the following major features: (1) A powerful geometric modeling environment; (2) A set of flexible routines for geometric interrogation; (3) A set of analytic modules which extend across

many of the disciplines which are a theme of this conference; (4) A link to Finite Element Mesh (FEM) generation; and (5) Support of above tools in a consistent, portable UNIX environment. GRA

N89-15104# Honeywell Systems and Research Center, Minneapolis, MN.
DISPLAY SYSTEMS DYNAMICS REQUIREMENTS FOR FLYING QUALITIES Final Report, Oct. 1986 - Dec. 1987
Kevin Boettcher, David K. Schmidt, and Lori Case 9 May 1988 188 p
(Contract F33615-86-C-3615)
(AD-A198275; Rept-88SRC12; AFWAL-TR-88-3017) Avail: NTIS HC A09/MF A01 CSCL 23B

This report summarizes research performed to develop a methodology for deciding requirements for display dynamics that ensure good flying qualities. To this end, a model-based approach was pursued that uses the optimal control model (OCM) of human operator behavior. One aspect of the investigation was to further establish the utility of the OCM in this context by correlating model-based quantities with flying qualities data from existing data bases. Another aspect was to consider how various factors at the pilot/display interface map into usual OCM perceptual parameters. A third element of the investigation was to examine the specific case of an STOL vehicle in an approach and landing configuration, with an explicity modeled processing delay in the HUD. This case study showed the negative impact of the delay and demonstrated how the introduction of additional display dynamics can compensate for its effect. Finally, a methodology for deciding display dynamics requirements has been suggested that is based on multivariable control theory, specifically the structured singular value. The methodology provides a means for assessing robustness of system performance and pilot workload to variations in pilot behavior and with respect to variable aircraft dynamics. It also incorporates a synthesis procedure that selects display dynamics so that a balance is achieved between optimal performance and adequate robustness. GRA

N89-15105# Aeronautical Systems Div., Wright-Patterson AFB, OH. Human Factors Branch.
F-16 AI/VVI (ATTITUDE INDICATORS/VERTICAL VELOCITY INDICATORS) EVALUATION: A COMPARISON OF FOUR CONFIGURATIONS Final Report, Apr. - Jun. 1987
R. A. Dudley, J. A. Hassoun, J. M. Gavern, P. B. Lovering, and M. C. Reynolds (Midwest Systems Research, Inc., Dayton, OH.) Aug. 1988 66 p
(AD-A199543; ASD-TR-88-5028) Avail: NTIS HC A04/MF A01 CSCL 01C

The experiment evaluated the effects of four different F-16C cockpit configurations on pilot's objective, subjective, and physiological responses in a simulated Instrument Landing System (ILS) approach. The four configurations were displayed by combining one of two Attitude Indicators (AI) and one of two Vertical Velocity Indicators (VVI). Following is a list of the four instruments: An AI with raw ILS data, an AI with Flight Director steering, a moving pointer VVI, and an improved tape VVI. Seven pilots flew 40 simulated ILS approaches each. Both performance and subjective data were in agreement in suggesting less pilot workload when the aircraft was equipped with Flight Director AI. The results were not conclusive in selecting one VVI over the other. However, it appears that a configuration on an AI with Flight Director steering commands along with a moving pointer VVI could lead to most efficient ILS approach performance. GRA

N89-15106*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Aerospace Engineering.
HIGH ALPHA FEEDBACK CONTROL FOR AGILE HALF-LOOP MANEUVERS OF THE F-18 AIRPLANE Final Technical Report, Apr. - Dec. 1988
Harold Stalford Dec. 1988 10 p
(Grant NAG1-873)
(NASA-CR-181360; NAS 1.26:181360) Avail: NTIS HC A02/MF A01 CSCL 01C

A nonlinear feedback control law for the F/A-18 airplane that provides time-optimal or agile maneuvering of the half-loop maneuver at high angles of attack is given. The feedback control law was developed using the mathematical approach of singular perturbations, in which the control devices considered were conventional aerodynamic control surfaces and thrusting. The derived nonlinear control law was used to simulate F/A-18 half-loop maneuvers. The simulated results at Mach 0.6 and 0.9 compared well with pilot simulations conducted at NASA. Author

N89-15107*# Sverdrup Technology, Inc., Cleveland, OH.
HASA: HYPERSONIC AEROSPACE SIZING ANALYSIS FOR THE PRELIMINARY DESIGN OF AEROSPACE VEHICLES Final Contractor Report
Gary J. Harloff and Brian M. Berkowitz Nov. 1988 60 p
(Contract NAS3-24105)
(NASA-CR-182226; E-4496; NAS 1.26:182226) Avail: NTIS HC A04/MF A01 CSCL 01C

A review of the hypersonic literature indicated that a general weight and sizing analysis was not available for hypersonic orbital, transport, and fighter vehicles. The objective here is to develop such a method for the preliminary design of aerospace vehicles. This report describes the developed methodology and provides examples to illustrate the model, entitled the Hypersonic Aerospace Sizing Analysis (HASA). It can be used to predict the size and weight of hypersonic single-stage and two-stage-to-orbit vehicles and transports, and is also relevant for supersonic transports. HASA is a sizing analysis that determines vehicle length and volume, consistent with body, fuel, structural, and payload weights. The vehicle component weights are obtained from statistical equations for the body, wing, tail, thermal protection system, landing gear, thrust structure, engine, fuel tank, hydraulic system, avionics, electral system, equipment payload, and propellant. Sample size and weight predictions are given for the Space Shuttle orbiter and other proposed vehicles, including four hypersonic transports, a Mach 6 fighter, a supersonic transport (SST), a single-stage-to-orbit (SSTO) vehicle, a two-stage Space Shuttle with a booster and an orbiter, and two methane-fueled vehicles. Author

N89-15108*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AN INITIATIVE IN MULTIDISCIPLINARY OPTIMIZATION OF ROTORCRAFT
Howard M. Adelman and Wayne R. Mantay (Army Aviation Systems Command, Hampton, VA.) Oct. 1988 37 p Presented at the 2nd NASA/AF Symposium on Recent Advances in Multidisciplinary Analysis and Optimization, Hampton, VA, 28-30 Sep. 1988
(NASA-TM-101523; NAS 1.15:101523; AVSCOM-TM-88-B-016)
Avail: NTIS HC A03/MF A01 CSCL 01C

Described is a joint NASA/Army initiative at the Langley Research Center to develop optimization procedures aimed at improving the rotor blade design process by integrating appropriate disciplines and accounting for important interactions among the disciplines. The activity is being guided by a Steering Committee made up of key NASA and Army researchers and managers. The committee, which has been named IRASC (Integrated Rotorcraft Analysis Steering Committee), has defined two principal foci for the activity: a white paper which sets forth the goals and plans of the effort; and a rotor design project which will validate the basic constituents, as well as the overall design methodology for multidisciplinary optimization. The paper describes the optimization formulation in terms of the objective function, design variables, and constraints. Additionally, some of the analysis aspects are discussed and an initial attempt at defining the interdisciplinary couplings is summarized. At this writing, some significant progress has been made, principally in the areas of single discipline optimization. Results are given which represent accomplishments in rotor aerodynamic performance optimization for minimum hover horsepower, rotor dynamic optimization for vibration reduction, and rotor structural optimization for minimum weight. Author

N89-15109*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.
THE EFFECTS OF EXCITATION WAVEFORMS AND SHAKER MOVING MASS ON THE MEASURED MODAL CHARACTERISTICS OF A 2- BY 5-FOOT ALUMINUM PLATE
David F. Voracek and Adolfo M. Morales Dec. 1988 24 p
(NASA-TM-100446; H-1502; NAS 1.15:100446) Avail: NTIS HC A03/MF A01 CSCL 01C

Ground vibration tests were conducted to compare and to investigate the effects of five excitation waveforms and the shaker moving mass (equipment and armature used to attach the shaker to the structure) on the experimental modal characteristics of a 2- by 5-ft aluminum plate using fast Fourier transform techniques. The five types of excitation waveforms studied were sine dwell, random, impact, sine sweep, and impulsive sine. The results showed that the experimental modal frequencies for all types of excitation were within 3 percent, while the modal damping data exhibited greater scatter. The sets of mode shapes obtained by the five types of excitation were consistent. The results of the shaker moving mass investigation on the 2- by 5-ft aluminum plate showed that modal frequency decreases and modal damping remains relatively constant with an increase in shaker moving mass. The generalized mass of the structure appears to decrease with an increase in shaker moving mass. In addition, it was seen that having a shaker near a node line can reduce some of the effects of the added shaker moving mass on the frequencies and the damping. Author

N89-15110*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
STRUCTURAL OPTIMIZATION OF ROTOR BLADES WITH INTEGRATED DYNAMICS AND AERODYNAMICS
Aditi Chattopadhyay (Analytical Services and Materials, Inc., Hampton, VA.) and Joanne L. Walsh Oct. 1988 26 p Presented at the 2nd NASA/Air Force Symposium on Recent Advances in Multidisciplinary Analysis and Optimization, Hampton, VA, 28-30 Sep. 1988
(NASA-TM-101512; NAS 1.15:101512) Avail: NTIS HC A03/MF A01 CSCL 01C

The problem of structural optimization of helicopter rotor blades with integrated dynamic and aerodynamic design considerations is addressed. Results of recent optimization work on rotor blades for minimum weight with constraints on multiple coupled natural flap-lag frequencies, blade autorotational inertia and centrifugal stress has been reviewed. A strategy has been defined for the ongoing activities in the integrated dynamic/aerodynamic optimization of rotor blades. As a first step, the integrated dynamic/airload optimization problem has been formulated. To calculate system sensitivity derivatives necessary for the optimization recently developed, Global Sensitivity Equations (GSE) are being investigated. A need for multiple objective functions for the integrated optimization problem has been demonstrated and various techniques for solving the multiple objective function optimization are being investigated. The method called the Global Criteria Approach has been applied to a test problem with the blade in vacuum and the blade weight and the centrifugal stress as the multiple objectives. The results indicate that the method is quite effective in solving optimization problems with conflicting objective functions. Author

N89-15111*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
RESULTS OF AN INTEGRATED STRUCTURE-CONTROL LAW DESIGN SENSITIVITY ANALYSIS
Michael G. Gilbert Dec. 1988 21 p Presented at the 2nd NASA/Air Force Symposium on Recent Experiences in Multidisciplinary Analysis and Optimization, Hampton, VA, Sep. 1988
(NASA-TM-101517; NAS 1.15:101517) Avail: NTIS HC A03/MF A01 CSCL 01C

Next generation air and space vehicle designs are driven by increased performance requirements, demanding a high level of design integration between traditionally separate design disciplines. Interdisciplinary analysis capabilities have been developed, for aeroservoelastic aircraft and large flexible spacecraft control for instance, but the requisite integrated design methods are only beginning to be developed. One integrated design method which has received attention is based on hierarchal problem decompositions, optimization, and design sensitivity analyses. This paper highlights a design sensitivity analysis method for Linear Quadratic Cost, Gaussian (LQG) optimal control laws, which predicts change in the optimal control law due to changes in fixed problem parameters using analytical sensitivity equations. Numerical results of a design sensitivity analysis for a realistic aeroservoelastic aircraft example are presented. In this example, the sensitivity of the optimally controlled aircraft's response to various problem formulation and physical aircraft parameters is determined. These results are used to predict the aircraft's new optimally controlled response if the parameter was to have some other nominal value during the control law design process. The sensitivity results are validated by recomputing the optimal control law for discrete variations in parameters, computing the new actual aircraft response, and comparing with the predicted response. These results show an improvement in sensitivity accuracy for integrated design purposes over methods which do not include changess in the optimal control law. Use of the analytical LQG sensitivity expressions is also shown to be more efficient that finite difference methods for the computation of the equivalent sensitivity information. Author

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

No abstracts in this category.

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxilliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N89-15112*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ANALYSIS OF AN UNSWEPT PROPFAN BLADE WITH A SEMIEMPIRICAL DYNAMIC STALL MODEL
T. S. R. Reddy (Toledo Univ., OH.) and K. R. V. Kaza Washington, DC Jan. 1989 23 p
(NASA-TM-4083; E-4196; NAS 1.15:4083) Avail: NTIS HC A03/MF A01 CSCL 21E

The time history response of a propfan wind tunnel model with dynamic stall is studied analytically. The response obtained from the analysis is compared with available experimental data. The governing equations of motion are formulated in terms of blade normal modes which are calculated using the COSMIC-NASTRAN computer code. The response analysis considered the blade plunging and pitching motions. The lift, drag and moment coefficients for angles of attack below the static stall angle are obtained from a quasi-steady theory. For angles above static stall angles, a semiempirical dynamic stall model based on a correction to angle of attack is used to obtain lift, drag and moment coefficients. Using these coefficients, the aerodynamic forces are calculated at a selected number of strips, and integrated to obtain the total generalized forces. The combined

momentum-blade element theory is used to calculate the induced velocity. The semiempirical stall model predicted a limit cycle oscillation near the setting angle at which large vibratory stresses were observed in an experiment. The predicted mode and frequency of oscillation also agreed with those measured in the experiment near the setting angle. Author

N89-15113 Pennsylvania State Univ., University Park.
A COUPLED, PARABOLIC-MARCHING METHOD FOR THE PREDICTION OF THREE-DIMENSIONAL VISCOUS INCOMPRESSIBLE TURBOMACHINERY FLOWS Ph.D. Thesis
Kevin Richard Kirtley 1987 217 p
Avail: Univ. Microfilms Order No. DA8807808

A coupled parabolic marching method was developed to solve the 3-D incompressible Navier-Stokes equation for turbulent turbomachinery flows. Earlier space marching methods were analyzed to determine their global stability during the multiple passes of the computational domain. The methods were found to be unconditionally unstable even when an extra equation for the pressure was used between passes of the domain. Also examined was the splitting error which arises from the use of the LBI scheme in a 3-D parabolic marching method. The splitting error was found to be extremely important for coarse grid computations and was analyzed and demonstrated for a strongly curved duct flow. Several turbulence models were introduced for the computation of turbulent flows. The three models used were the algebraic eddy viscosity model, the two equation k-epsilon model, and the algebraic Reynolds stress model which introduces the strong effect of rotation on the turbulence structure. The new parabolic marching method using the new solution method was used to compute several flows including the laminar and turbulent flow in a S shaped duct and the turbulent flow in an end wall cascade and compressor rotor. Dissert. Abstr.

N89-15114*# Calspan-Buffalo Univ. Research Center, NY.
DEVELOPMENT OF AN INTEGRATED BEM APPROACH FOR HOT FLUID STRUCTURE INTERACTION Annual Report, Nov. 1987 - Nov. 1988
Gary F. Dargush, Prasanta K. Banerjee, and Keith A. Honkala (Buffalo Univ., NY.) 20 Dec. 1988 114 p
(Grant NAG3-712)
(NASA-CR-184587; NAS 1.26:184587) Avail: NTIS HC A06/MF A01 CSCL 21E

In the present work, the boundary element method (BEM) is chosen as the basic analysis tool, principally because the definition of temperature, flux, displacement and traction are very precise on a boundary-based discretization scheme. One fundamental difficulty is, of course, that a BEM formulation requires a considerable amount of analytical work, which is not needed in the other numerical methods. Progress made toward the development of a boundary element formulation for the study of hot fluid-structure interaction in Earth-to-Orbit engine hot section components is reported. The primary thrust of the program to date has been directed quite naturally toward the examination of fluid flow, since boundary element methods for fluids are at a much less developed state. Author

N89-15115# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.
MEASUREMENT UNCERTAINTY OF THE AGARD/PEP UNIFORM ENGINE TEST PROGRAM
J. P. K. Vleghert 30 Jun. 1987 17 p Presented at the AGARD Fluid Dynamics Panel Symposium on Aerodynamic Data Accuracy and Quality, Naples, Italy, 28 Sep. - 1 Oct. 1987
(NLR-MP-87040-U; ETN-89-93884) Avail: NTIS HC A03/MF A01

In the AGARD/PEP Uniform Engine Test Program two engines were tested in eight facilities in five different countries to compare measuring practices and results. Uncertainty assessment according to the method proposed by Abernethy (1973), in which the total uncertainty is split in a random error (scatter, precision) and a bias error or offset is discussed. The results show that the random error is small but that appreciable bias error exists between participants. ESA

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

N89-15116*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
FLIGHT TESTS OF THREE-DIMENSIONAL PATH-REDEFINITION ALGORITHMS FOR TRANSITION FROM RADIO NAVIGATION (RNAV) TO MICROWAVE LANDING SYSTEM (MLS) NAVIGATION WHEN FLYING AN AIRCRAFT ON AUTOPILOT
Richard M. Hueschen 1988 23 p
(NASA-TM-4089; L-16458; NAS 1.15:4089) Avail: NTIS HC A03/MF A01 CSCL 01C

This report contains results of flight tests for three path update algorithms designed to provide smooth transition for an aircraft guidance system from DME, VORTAC, and barometric navaids to the more precise MLS by modifying the desired 3-D flight path. The first algorithm, called Zero Cross Track, eliminates the discontinuity in cross-track and altitude error at transition by designating the first valid MLS aircraft position as the desired first waypoint, while retaining all subsequent waypoints. The discontinuity in track angle is left unaltered. The second, called Tangent Path, also eliminates the discontinuity in cross-track and altitude errors and chooses a new desired heading to be tangent to the next oncoming circular arc turn. The third, called Continued Track, eliminates the discontinuity in cross-track, altitude, and track angle errors by accepting the current MLS position and track angle as the desired ones and recomputes the location of the next waypoint. The flight tests were conducted on the Transportation Systems Research Vehicle, a small twin-jet transport aircraft modified for research under the Advanced Transport Operating Systems program at Langley Research Center. The flight tests showed that the algorithms provided a smooth transition to MLS. Author

N89-15117 Arizona Univ., Tucson.
SOME NEW RESULTS ON THE STABILIZATION AND STATE ESTIMATION IN LARGE-SCALE SYSTEMS BY DECENTRALIZED AND MULTI-LEVEL SCHEMES Ph.D. Thesis
Refaat Mohammed Elbanna 1988 274 p
Avail: Univ. Microfilms Order No. DA8814230

There are three main objectives. The first objective is concerned with the stabilization of large scale systems by a decentralized control. The fundamental idea behind this type of control is the stabilization of the isolated subsystems of a large scale system in such a way that the global stability requirement is also satisfied. The second objective is to investigate the problem of the stabilization of a class of large scale systems which are composed of identical subsystems and identical interconnections. For this class of systems, certain significant theorems, concerning the qualitative properties are introduced. The third objective concerns the development of a few different schemes for the design of an asymptotic state estimator for large scale systems described as interconnections of several low order subsystems. The most attractive feature of the scheme is that the majority of the necessary computations are performed at the subsystem level only. All of the results of the objectives are illustrated by numerical examples. Dissert. Abstr.

N89-15118*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
IN-FLIGHT SIMULATION INVESTIGATION OF ROTORCRAFT PITCH-ROLL CROSS COUPLING

Douglas C. Watson and William S. Hindson Dec. 1988 41 p
(NASA-TM-101059; A-89016; NAS 1.15:101059) Avail: NTIS HC A03/MF A01 CSCL 01C

An in-flight simulation experiment investigating the handling qualities effects of the pitch-roll cross-coupling characteristic of single-main-rotor helicopters is described. The experiment was conducted using the NASA/Army CH-47B variable stability helicopter with an explicit-model-following control system. The research is an extension of an earlier ground-based investigation conducted on the NASA Ames Research Center's Vertical Motion Simulator. The model developed for the experiment is for an unaugmented helicopter with cross-coupling implemented using physical rotor parameters. The details of converting the model from the simulation to use in flight are described. A frequency-domain comparison of the model and actual aircraft responses showing the fidelity of the in-flight simulation is described. The evaluation task was representative of nap-of-the-Earth maneuvering flight. The results indicate that task demands are important in determining allowable levels of coupling. In addition, on-axis damping characteristics influence the frequency-dependent characteristics of coupling and affect the handling qualities. Pilot technique, in terms of learned control crossfeeds, can improve performance and lower workload for particular types of coupling. The results obtained in flight corroborated the simulation results. Author

N89-15119# Royal Air Force Coll., Cranwell (England). Dept. of Electrical and Electronic Engineering.
APPLICATION OF FORSYTHE METHOD IN STABILIZING AND DECOUPLING SPEED AND HEIGHT IN F4 PHANTOM AIRCRAFT M.S. Thesis
R. J. Thomasson 1988 167 p Prepared in cooperation with Loughborough Univ. of Technology (England)
(ETN-89-93566) Avail: NTIS HC A08/MF A01

Output feedback and cascade compensation are used to develop the control system. Solutions are numerically evaluated for three points in the flight envelope: Point A Mach 0.2 at sea level, point B Mach 1.1 at sea level, and point C Mach 1.8 at 16764 m. The methodology is basically a frequency response approach, use being made of root locus diagrams and Nyquist plots. The acceptability of the solutions was verified by setting a digital simulation. The results show that the Forsythe method is apt to achieve stabilization and decoupling using relatively simple compensation elements. ESA

N89-15120# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
STATISTICAL PROPERTIES OF ATMOSPHERIC TURBULENCE RELEVANT TO THE CALCULATION OF AIRPLANE LOADS
R. Noback 22 Jan. 1988 103 p
(Contract OV/RLD-737)
(NLR-TR-88013-U; ETN-89-93892) Avail: NTIS HC A06/MF A01

Measured time histories of atmospheric turbulence were analyzed. Distribution functions and exceedance curves of the turbulence and its derivative are presented. The load exceedance curves of various mathematical airplane models due to these turbulence patches were calculated. Deviations of the properties of these patches from the assumed properties used in the power spectral density method are investigated. ESA

N89-15121*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
DETERMINATION OF LONGITUDINAL AERODYNAMIC DERIVATIVES USING FLIGHT DATA FROM AN ICING RESEARCH AIRCRAFT
R. J. Ranaudo, J. G. Batterson, A. L. Reehorst, T. H. Bond, and T. M. OMara (George Washington Univ., Washington, DC.) 1989 19 p Presented at the 27th Aerospace Sciences Meeting, Reno, NV, 9-12 Jan. 1989; sponsored by AIAA
(NASA-TM-101427; E-4528; NAS 1.15:101427; AIAA-89-0754)
Avail: NTIS HC A03/MF A01 CSCL 01C

A flight test was performed with the NASA Lewis Research Center's DH-6 icing research aircraft. The purpose was to employ a flight test procedure and data analysis method, to determine the accuracy with which the effects of ice on aircraft stability and control could be measured. For simplicity, flight testing was restricted to the short period longitudinal mode. Two flights were flown in a clean (baseline) configuration, and two flights were flown with simulated horizontal tail ice. Forty-five repeat doublet maneuvers were performed in each of four test configurations, at a given trim speed, to determine the ensemble variation of the estimated stability and control derivatives. Additional maneuvers were also performed in each configuration, to determine the variation in the longitudinal derivative estimates over a wide range of trim speeds. Stability and control derivatives were estimated by a Modified Stepwise Regression (MSR) technique. A measure of the confidence in the derivative estimates was obtained by comparing the standard error for the ensemble of repeat maneuvers, to the average of the estimated standard errors predicted by the MSR program. A multiplicative relationship was determined between the ensemble standard error, and the averaged program standard errors. In addition, a 95 percent confidence interval analysis was performed for the elevator effectiveness estimates, C sub m sub delta e. This analysis identified the speed range where changes in C sub m sub delta e could be attributed to icing effects. The magnitude of icing effects on the derivative estimates were strongly dependent on flight speed and aircraft wing flap configuration. With wing flaps up, the estimated derivatives were degraded most at lower speeds corresponding to that configuration. With wing flaps extended to 10 degrees, the estimated derivatives were degraded most at the higher corresponding speeds. The effects of icing on the changes in longitudinal stability and control derivatives were adequately determined by the flight test procedure and the MSR analysis method discussed herein. Author

N89-15122*# Pennsylvania State Univ., University Park. Dept. of Aerospace Engineering.
PREDICTION OF FORCES AND MOMENTS FOR FLIGHT VEHICLE CONTROL EFFECTORS: WORKPLAN Progress Report
Mark D. Maughmer Jan. 1989 41 p
(Grant NAG1-849)
(NASA-CR-184666; NAS 1.26:184666) Avail: NTIS HC A03/MF A01 CSCL 01C

Two research activities directed at hypersonic vehicle configurations are currently underway. The first involves the validation of a number of classical local surface inclination methods commonly employed in preliminary design studies of hypersonic flight vehicles. Unlike studies aimed at validating such methods for predicting overall vehicle aerodynamics, this effort emphasizes validating the prediction of forces and moments for flight control studies. Specifically, several vehicle configurations for which experimental or flight-test data are available are being examined. By comparing the theoretical predictions with these data, the strengths and weaknesses of the local surface inclination methods can be ascertained and possible improvements suggested. The second research effort, of significance to control during take-off and landing of most proposed hypersonic vehicle configurations, is aimed at determining the change due to ground effect in control effectiveness of highly swept delta planforms. Central to this research is the development of a vortex-lattice computer program which incorporates an unforced trailing vortex sheet and an image ground plane. With this program, the change in pitching moment of the basic vehicle due to ground proximity, and whether or not there is sufficient control power available to trim, can be determined. In addition to the current work, two different research directions are suggested for future study. The first is aimed at developing an interactive computer program to assist the flight controls engineer in determining the forces and moments generated by different types of control effectors that might be used on hypersonic vehicles. The first phase of this work would deal in the subsonic portion of the flight envelope, while later efforts would explore the supersonic/hypersonic flight regimes. The second proposed research direction would explore methods for determining the

aerodynamic trim drag of a generic hypersonic flight vehicle and ways in which it can be minimized through vehicle design and trajectory optimization. Author

N89-15123*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, CA.
DERIVATION AND DEFINITION OF A LINEAR AIRCRAFT MODEL
Eugene L. Duke, Robert F. Antoniewicz, and Keith D. Krambeer Aug. 1988 106 p
(NASA-RP-1207; H-1391; NAS 1.61:1207) Avail: NTIS HC A06/MF A01 CSCL 01C

A linear aircraft model for a rigid aircraft of constant mass flying over a flat, nonrotating earth is derived and defined. The derivation makes no assumptions of reference trajectory or vehicle symmetry. The linear system equations are derived and evaluated along a general trajectory and include both aircraft dynamics and observation variables. Author

N89-15600*# Titan Systems, Inc., Gardena, CA.
CONCEPTS FOR AUTONOMOUS FLIGHT CONTROL FOR A BALLOON ON MARS
Thomas F. Heinsheimer, Robyn C. Friend, and Neil G. Siegel (Siegel, Neil G., Redondo Beach, CA) *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 391-400 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 01A

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N89-15124# Dundee Univ. (Scotland). Dept. of Civil Engineering.
ALTERNATIVE MODIFIED BINDERS FOR AIRFIELD PAVEMENTS Final Report, Aug. 1986 - Mar. 1988
A. F. Stock Mar. 1988 106 p
(Contract DAJA45-86-C-0043; DA Proj. 1L1-61102-BH-57)
(AD-A197902; R/D-5499-EN-01) Avail: NTIS HC A06/MF A01 CSCL 13B

The technical object of this research was to investigate materials, to modify, augment, extend and/or replace conventional asphalt cement binders for flexible airfield pavements, capable to sustain aircraft tire pressures of 350/400 psi. This study looked at a number of alternate materials and modified materials to determine their acceptability for producing the mixtures. There was a thorough review of the published literature concerning additive types, their effect on the properties of binders and mixers. Selection of a series of test procedures and development of a testing program to screen additives for their suitability for combination with bitumen, determine mix design procedures, and to measure the structural and mechanical properties of mixes was done. It may be concluded that aircraft fitted with vectored thrust can cause additional structural damage to pavements as a result of heating effects. It is also concluded that erosion is possible as a result of the blast from the vectored thrust. It is recommended that the operating parameters of aircraft using vectored thrust be investigated as this has considerable significance in relation to the damage potential. The analysis in this report provides sufficient data for a preliminary assessment of the probability of damage, therefore permitting a decision in relation to further investigation. GRA

N89-15125# Stanford Univ., CA. Dept. of Chemistry.
SPECTROSCOPIC AND LIGHT SCATTERING INSTRUMENTATION PROPOSAL Final Report, 1 Jan. 1985 - 31 Dec. 1987
John Ross, Mark A. Schell, and Benjamin Irvin 31 Dec. 1987 5 p
(Grant AF-AFOSR-0096-85; AF Proj. 2917)
(AD-A199991; AFOSR-88-1065TR) Avail: NTIS HC A02/MF A01 CSCL 14B

The equipment purchased on this grant falls into three categories: The first consists of components for four apparatus systems used for the study of oscillatory reactions and the effects of external periodic perturbations on such reactions. The second category includes generally used instrumentation including a storage oscilloscope, a visible spectrometer a thermostat bath, an analytical balance, a ph meter and strip chart recorder. The third category is computers and components including upgrading for laboratory computers on hand, computer networking hardware, computer data acquisition elements (both hardware and software) used in all the experiments as well as theoretical work, associated with the experiments. GRA

N89-15126# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.
TECHNOLOGY INVOLVED IN THE SIMULATION OF MOTION CUES: THE CURRENT TREND
H. A. Mooij 30 Sep. 1987 19 p Presented at the AGARD Aerospace Medical Panel Symposium on Motion Cues in Flight Simulation and Simulator Sickness, Brussels, Belgium, 28 Sep. - 2 Oct. 1987
(NLR-MP-87060-U; ETN-89-93885) Avail: NTIS HC A03/MF A01

Flight simulators and simulator sickness are introduced, and trends in visual and motion systems are reviewed. The basic cueing methodology in flight simulation, and developments in image generation, image display, platform motion cue generation, and motion hardware mechanisms are discussed. The importance of maintenance and calibration of flight simulator installations is mentioned. ESA

N89-15127# European Space Agency, Paris (France).
THE TRANSONIC WIND TUNNEL (TWB) AT DFVLR IN BRAUNSCHWEIG (FEDERAL REPUBLIC OF GERMANY) Status Report, 1987
Wolfgang Puffert-Meissner (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick, Germany, F.R.) Nov. 1988 45 p Transl. into ENGLISH of Der Transsonische Windkanal (TWB) der DFVLR in Braunschweig (Brunswick, Fed. Republic of Germany, DFVLR), Dec. 1987 47 p Original language document was announced as N88-22909
(ESA-TT-1114; DFVLR-Mitt-88-01; ETN-89-93908) Avail: NTIS HC A03/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 30.50 Deutsche marks

The transonic wind tunnel Braunschweig is a pressurized blowdown wind tunnel. The test section for two-dimensional airfoil testing has an area of 0.34 x 0.60 m. Mach number range is from 0.3 to 0.95 and Reynolds number range from 2,900,000 to 12 million at Mach 0.7, based on an airfoil chord length of 150 mm. Information required for the preliminary planning of test programs and for preliminary layout of models used in such programs is given. ESA

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N89-15128# Los Alamos National Lab., NM.
LABORATORY PERFORMANCE OF THE BEAR (BEAM EXPERIMENT ABOARD ROCKET) RFQ (RADIO-FREQUENCY QUADRUPOLE)
P. G. OShea, D. L. Schrage, L. M. Young, T. J. Zaugg, M. T. Lynch, K. F. McKenna, and L. D. Hansborough 1988 12 p Presented at the International Conference on the Application of Accelerators in Research and Industry, Denton, TX, 7 Nov. 1988

(Contract W-7405-eng-36)
(DE89-000320; LA-UR-88-3236; CONF-881151-2) Avail: NTIS HC A03/MF A01

The BEAR (Beam Experiment Aboard Rocket) accelerator will be part of an experiment to demonstrate the operation of an ion accelerator in space and to characterize the exoatmospheric propagation of a neutral particle beam. The RFQ (radio-frequency quadrupole) has been designed to produce a 25-mA H (-) beam with an emittance of 0.01 cm-mrad (rms normalized) at an energy of 1 MeV. Because of the rigors of spaceflight, the accelerator design has been constrained by factors not normally applicable to conventional terrestrial accelerators. These factors and the mechanical features are described in a companion paper in these proceedings. The design techniques developed for BEAR would be applicable whenever, rugged, lightweight, or power-efficient systems are required. The BEAR RFQ has been operated under power with beam in the laboratory. This paper details of measured beam transport, emittance, and energy spectra. DOE

N89-15129# European Space Agency, Paris (France).
AQUARACK: AIM AND POSSIBLE RESEARCH PROJECTS
Oct. 1988 91 p Transl. into ENGLISH from Das Aquarack. Rahmendisposition und Moegliche Wissenschaftliche Projekte (Cologne, Fed. Republic of Germany, DFVLR), 1987 97 p Workshop held in Cologne, Fed. Republic of Germany, 6 Jun. 1986 Original language document was announced as N88-10469
(ESA-TT-1083; DFVLR-Mitt-87-01; ETN-89-93631) Avail: NTIS HC A05/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 33.50 Deutsche marks

The research possibilities offered by the long term maintenance system for aquatic organisms, Aquarack, are discussed. The reproduction biology of the genus Xiphophorus was investigated. The Xiphophorus system and its possible applications for biological studies in a microgravity environment were examined. Long term investigations of the growth, metabolism, and reproduction of fish under conditions close to weightlessness are proposed. The functional plasticity of the nervous system of vertebrates was investigated. The influence of weightlessness on behavior, reproduction, and metabolism of the freshwater snail Biomphalaria glabrata was studied. The usefulness of microalgal structures as an element of closed ecological systems is discussed. The state of the art of space life support systems for biological experiments under weightlessness is surveyed. For individual titles, see N89-15130 through N89-15137.

N89-15130# Ruhr Univ., Bochum (Germany, F.R.). Arbeitsgruppe fuer Verleichende Endokrinologie.
THE AQUARACK AS A POTENTIAL INSTRUMENT FOR FUNDAMENTAL BIOLOGICAL RESEARCH IN SPACE: INVENTORY AND SCIENTIFIC DISPOSITIONS **c35**
Volker Bluem *In* ESA, Aquarack: Aim and Possible Research Projects Oct. 1988 p 7-15 Transl. into ENGLISH from Das Aquarack. Rahmendisposition und Moegliche Wissenschaftleche Projekte (Cologne, Fed. Republic of Germany, DFVLR), 1987 p 9-18 Original language document was announced as N88-10470 (For primary document see N89-15129 07-12)
Avail: NTIS HC A05/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 33.50 Deutsche marks

The research possibilities offered by the prototype of a long-term maintenance system for aquatic organisms, Aquarack, are discussed. The construction principles of the Aquarack are described. Three possible levels of scientific work are outlined. The first includes the construction of a prototype and its testing using methods of reproductive and metabolic physiology. The second contains the space-adapted final version within a spacelab and its examinations using developed methods. The last level involves a series of special projects with high scientific value, provided by different users. ESA

N89-15131# Ruhr Univ., Bochum (Germany, F.R.). Arbeitsgruppe fuer Verletchende Endokrinologie.
INVESTIGATIONS OF THE SURVEY OF THE REPRODUCTIVE BIOLOGY OF XIPHOPHORUS IN AN AQUARACK **c51**
Volker Bluem and Ruediger Schulz *In* ESA, Aquarack: Aim and Possible Research Projects Oct. 1988 p 17-25 Transl. into ENGLISH from Das Aquarack. Rahmendisposition und Moegliche Wissenschaftliche Projekte (Cologne, Fed. Republic of Germany, DFVLR), 1987 p 19-27 Original language document was announced as N88-10471 (For primary document see N89-15129 07-12)
Avail: NTIS HC A05/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 33.50 Deutsche marks

The reproduction biology of the genus Xiphophorus was investigated in the long term maintenance system Aquarack. The availability of a long term maintenance system and a successful reproduction in this system are discussed as prequisites for biological science and for application-oriented research, dealing with boney fish in consecutive generations in a microgravity environment. The particular suitability of the genus Xiphophorus as experimental animal is explained, and the most important endocrine system regulating reproduction is outlined. ESA

N89-15132# Giessen Univ. (Germany, F.R.). Inst. fuer Genetische.
XIPHOPHORUS AS AN EXPERIMENTAL SYSTEM FOR GENETIC AND BIOLOGICAL DEVELOPMENT STUDIES UNDER MICROGRAVITY CONDITIONS **c29**
Markus Schmidt and Fritz Anders *In* ESA, Aquarack: Aim and Possible Research Projects Oct. 1988 p 26-33 Transl. into ENGLISH from Das Aquarack. Rahmendisposition und Moegliche Wissenschaftliche Projekte (Cologne, Fed. Republic of Germany, DFVLR), 1987 p 29-36 Original language document was announced as N88-10472 (For primary document see N89-15129 07-12)
Avail: NTIS HC A05/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 33.50 Deutsche marks

The Xiphophorus system and its possible applications for biological studies in a microgravity environment were examined. By selective intra and interspecific crossing and backcrossings of wild types and mutants of Xiphophorus, an experimental system of 60 different, defined genotypes was constructed. Among these are strains that specifically react by neoplastic transformation after the application of mutagens and differentiation promotors. This and the comprehensive characterization of the system allow a large number of experiments in a space mission to examine the influence of cosmic radiation and weightlessness on genetics, physiology, development, morphology, histology, and cytology of the fish. ESA

N89-15133# Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
LONG TERM INVESTIGATIONS OF THE GROWTH, METABOLISM, AND REPRODUCTION OF FISH UNDER CONDITIONS CLOSE TO WEIGHTLESSNESS **c29**
Rainer Froese *In* ESA, Aquarack: Aim and Possible Research Projects Oct. 1988 p 34-42 Transl. into ENGLISH from Das Aquarack. Rahmendisposition und Moegliche Wissenschaftliche Projekte (Cologne, Fed. Republic of Germany, DFVLR), 1987 p 37-45 Original language document was announced as N88-10473 .(For primary document see N89-15129 07-12)
Avail: NTIS HC A05/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 33.50 Deutsche marks

The investigation of growth metabolism, and reproduction of several generations of fish of the genus Xiphophorus, in a future space station, is proposed. The different subjects to be investigated are outlined. The proposed materials and methods are presented. The data are planned to be collected indirectly, i.e., by video cameras and photoelectric cells. Cooperation with other research

projects is planned. Findings for the development of closed ecological life support systems are expected. ESA

N89-15134# Stuttgart Univ. (Germany, F.R.). Inst. fuer Zoologie.
FUNCTIONAL PLASTICITY OF THE NERVOUS SYSTEM OF VERTEBRATES **c51**
Hinrich Rahmann and Wolfgang Probst *In* ESA, Aquarack: Aim and Possible Research Projects Oct. 1988 p 43-55 Transl. into ENGLISH from Das Aquarack. Rahmendisposition und Moegliche Wissenschaftliche Projekte (Cologne, Fed. Republic of Germany, DFVLR), 1987 p 47-59 Original language document was announced as N88-10474 (For primary document see N89-15129 07-12)
Avail: NTIS HC A05/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 33.50 Deutsche marks

The development, behavior, and adaptability of the central nervous system (CNS) of fishes, especially the tactum opticum, were investigated using optical and electron microscopes, as well as biochemical methods. Following light versus dark rearing, and adaptation to the cold versus warmth, an ultra structural neuronal plasticity is observed, especially concerning the sites of synapses. Synapses with different activity can be determined by different enrichments of extracellular calcium in the synaptic cleft and by the ultracytochemical observation of the activity of the doubly-ionized-Ca-ion-ATPase in the CNS. Using such ultra structural parameters, the influence of microgravity on the structure and function-related neuronal plasticity of the CNS of vertebrates can be investigated during the early ontogenetic development as well as in the adult state. ESA

N89-15135# Hamburg Univ. (Germany, F.R.). Inst. fuer Zoologie.
THE INFLUENCE OF WEIGHTLESSNESS ON THE METABOLISM IN BIOMPHALARIA GLABRATA **c51**
Wilhelm Becker *In* ESA, Aquarack: Aim and Possible Research Projects Oct. 1988 p 56-65 Transl. into ENGLISH from Das Aquarack. Rahmendisposition und Moegliche Wissenschaftliche Projekte (Cologne, Fed. Republic of Germany, DFVLR), 1987 p 61-68 Original language document was announced as N88-10475 (For primary document see N89-15129 07-12)
Avail: NTIS HC A05/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 33.50 Deutsche marks

The influence of weightlessness on behavior, reproduction, and metabolism of the freshwater snail Biomphalaria glabrata (Pulmonata) was investigated. A method for the continuous recording of heartbeat frequency and heart minute volume in the uninjured animal was developed and successfully tested under gravity conditions. The results are planned to be used to determine the effect of the gravitational force on the open circulatory system of this snail. ESA

N89-15136# Bonn Univ. (Germany, F.R.). Inst. fuer Botanie.
THE USEFULNESS OF MICROALGAL STRUCTURES AS AN ELEMENT OF CLOSED ECOLOGICAL SYSTEMS LIKE AQUARACK AND CELSS **c51**
Karlheinz Kreuzberg *In* ESA, Aquarack: Aim and Possible Research Projects Oct. 1988 p 66-74 Transl. into ENGLISH from Das Aquarack. Rahmendisposition und Moegliche Wissenschaftliche Projekte (Cologne, Fed. Republic of Germany, DFVLR), 1987 p 69-76 Original language document was announced as N88-10476 (For primary document see N89-15129 07-12)
Avail: NTIS HC A05/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 33.50 Deutsche marks

The usefulness of continuous cultures of green algae, such as Scenedesmus, Chlorella, Chlamydomonas, and Chlorogonium, was examined with respect to the regeneration of oxygen and the reassimilation of CO2 and ammonia. The most important advantages of microalgal cultures are a low demand of space, controlled and selfregulated cell growth, high metabolism rates, efficient energy transfer, a well balanced carbon and nitrogen recovery, and suitability for human food. Further investigations for the development of a practicable algal module for closed ecological systems are proposed. ESA

N89-15137# Dornier-Werke G.m.b.H., Friedrichshafen (Germany, F.R.).
LIFE SUPPORT SYSTEMS FOR BIOLOGICAL EXPERIMENTS UNDER WEIGHTLESSNESS IN THE GERMAN AND EUROPEAN SPACE PROGRAMS **c29**
Wolfram Lork and Rainer Stoepler *In* ESA, Aquarack: Aim and Possible Research Projects Oct. 1988 p 75-90 Transl. into ENGLISH from Das Aquarack. Rahmendisposition und Moegliche Wissenschaftliche Projekte (Cologne, Fed. Republic of Germany, DFVLR), 1987 p 77-93 Original language document was announced as N88-10477 (For primary document see N89-15129 07-12)
Avail: NTIS HC A05/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 33.50 Deutsche marks

The state of the art of space life support systems is surveyed. The tendency to the development of closed loop systems is emphasized. The configuration of several life support systems, such as the Spacelab Environmental Control and Life Support System, biorack and biological incubators, a botany facility and solar plant growth facility, a fish incubator, the Environmental Life Support System and Biological Life Support System, the Controlled Ecological Life Support Systems, and Aquarack, is described. Proposals for further research are given. ESA

N89-15138# MATRA Espace, Paris-Velizy (France).
STUDY ON FACILITIES FOR LONG MARCH FLIGHT OPPORTUNITIES, VOLUME 1 Final Report
R. Krieger, L. Bjorn (Swedish Space Corp., Solna.), C. Chipaux, H. Ahlborn, T. Carlberg, M. Jonsson, and B. Passerone Paris, France ESA 11 May 1988 40 p
(Contract ESA-7383/87-F-FL(SC))
(MATRA-PED/AO/003/CC/CB-Vol-1; ESA-CR(P)-2640-Vol-1; ETN-89-93648) Copyright Avail: NTIS HC A03/MF A01

The possibility of ESA using Chinese launchers was examined. Candidate experiments to fly in piggy-back mode were a critical point facility; high precision thermostat; electrophoresic orientation; crystal growth furnaces; isothermal furnaces; and thermostated passive experiments. Except for electromagnetic compatibility, that needs to be experimentally checked-out, all interfaces are cleared and accommodation is reasonably easy. Timetable constraints are reasonable, although they are extremely severe in view of a flight in 1988 and even tight for a flight in 1989. ESA

N89-15139# MATRA Espace, Paris-Velizy (France).
STUDY ON FACILITIES FOR LONG MARCH FLIGHT OPPORTUNITIES, VOLUME 2 Final Report
R. Krieger, L. Bjorn (Swedish Space Corp., Solna.), C. Chipaux, H. Ahlborn, T. Carlberg, M. Jonsson, and B. Passerone Paris, France ESA 11 May 1988 151 p
(Contract ESA-7383/87-F-FL(SC))
(MATRA-PED/AO/003/CC/CB-Vol-2; ESA-CR(P)-2640-Vol-2; ETN-89-93649) Copyright Avail: NTIS HC A08/MF A01

The possibility of ESA using Chinese launchers was examined. Candidate experiments to fly in piggy-back mode were a critical point facility; high precision thermostat; electrophoresic orientation; crystal growth furnaces; isothermal furnaces; and thermostatted passive experiments. Except for electromagnetic compatibility, that needs to be experimentally checked out, all interfaces are cleared and accommodation is reasonably easy. Timetable constraints are reasonable, although they are extremely severe in view of a flight in 1988 and even tight for a flight in 1989. ESA

N89-15140# National Aerospace Lab., Amsterdam (Netherlands). Space Div.
INTRODUCTION TO POSSIBLE MEANS OF EXPERIMENT OPERATIONS ON THE SPACE STATION

J. P. B. Vreeburg 11 Jan. 1988 49 p Sponsored by the Netherlands Agency for Aerospace Programs, Delft
(NLR-TR-88009-U; ETN-89-93890) Avail: NTIS HC A03/MF A01

Space station system design, components, and utilization characteristics are reviewed. A case study of a man-tended free flyer payload is discussed. ESA

N89-15141*# National Aeronautics and Space Administration, Washington, DC.
A PRELIMINARY STUDY OF MARS ROVER/SAMPLE RETURN MISSIONS
Jan. 1987 92 p Original document contains color illustrations
(NASA-TM-101218; NAS 1.15:101218) Avail: NTIS HC A05/MF A01 CSCL 22A

The Solar System Exploration Committee (SSEC) of the NASA Advisory Council recommends that a Mars Sample Return mission be undertaken before the year 2000. Comprehensive studies of a Mars Sample Return mission have been ongoing since 1984. The initial focus of these studies was an integrated mission concept with the surface rover and sample return vehicle elements delivered to Mars on a single launch and landed together. This approach, to be carried out as a unilateral U.S. initiative, is still a high priority goal in an Augmented Program of exploration, as the SSEC recommendation clearly states. With this background of a well-understood mission concept, NASA decided to focus its 1986 study effort on a potential opportunity not previously examined; namely, a Mars Rover/Sample Return (MRSR) mission which would involve a significant aspect of international cooperation. As envisioned, responsibility for the various mission operations and hardware elements would be divided in a logical manner with clearly defined and acceptable interfaces. The U.S. and its international partner would carry out separately launched but coordinated missions with the overall goal of accomplishing in situ science and returning several kilograms of surface samples from Mars. Important considerations for implementation of such a plan are minimum technology transfer, maximum sharing of scientific results, and independent credibility of each mission role. Under the guidance and oversight of a Mars Exploration Strategy Advisory Group organized by NASA, a study team was formed in the fall of 1986 to develop a preliminary definition of a flight-separable, cooperative mission. The selected concept assumes that the U.S. would undertake the rover mission with its sample collection operations and our international partner would return the samples to Earth. Although the inverse of these roles is also possible, this study report focuses on the rover functions of MRSR because rover operations have not been studied in as much detail as the sample return functions of the mission.
Author

N89-15142# National Academy of Sciences - National Research Council, Washington, DC. Commission on Physical Sciences, Mathematics and Resources.
SPACE SCIENCE IN THE TWENTY-FIRST CENTURY: IMPERATIVES FOR THE DECADES 1995 TO 2015, OVERVIEW
1988 105 p
(LC-87-43329; ISBN-0-309-03838-3) Avail: NTIS HC A06/MF A01

The opportunities for space science in the period from 1995 to 2015 are discussed. A perspective on progress in the six disciplines (the planet Earth; planetary and lunar exploration; solar system space physics; astronomy and astrophysics; fundamental physics and chemistry; and life sciences) of space science are reviewed. The prospectives for major achievements by 1995 from missions already underway or awaiting new starts are included. A set of long range goals for these disciplines are presented for the first two decades of the twenty-first century. Broad themes for future scientific pursuits are presented and some examples of high-priority missions for the turn of the century are highlighted. A few recommendations are cited for each discipline to suggest how these themes might be developed. Author

N89-15143# National Academy of Sciences - National Research Council, Washington, DC. Commission on Physical Sciences, Mathematics and Resources.
SPACE SCIENCE IN THE TWENTY-FIRST CENTURY: IMPERATIVES FOR THE DECADES 1995 TO 2015. MISSION TO PLANET EARTH
1988 37 p
(LC-87-43336; ISBN-0-309-03890-1) Avail: NTIS HC A03/MF A01

A unified program is outlined for studying the Earth, from its deep interior to its fluid envelopes. A system is proposed for measuring devices involving both space-based and in-situ observations that can accommodate simultaneously a large range of scientific needs. The scientific objectices served by this integrated infrastructure are cased into a framework of four grand themes. In summary these are: to determine the composition, structure, dynamics, and evolution of the Earth's crust and deeper interior; to establish and understand the structure, dynamics, and chemistry of the oceans, atmosphere, and cryosphere, and their interaction with the solid Earth; to characterize the history and dynamics of living organisms and their interaction with the environment; and to monitor and understand the interaction of human activities with the natural environment. A focus on these grand themes will help to understand the origin and fate of the planet, and to place it in the context of the solar system. Author

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

N89-15144*# Eagle Engineering, Inc., Houston, TX.
TRAJECTORY ANALYSIS OF TRANSFERS BETWEEN L4 AND L5 AND LOW LUNAR ORBIT
30 Oct. 1988 34 p
(Contract NAS9-17878)
(NASA-CR-172101; NAS 1.26:172101; EEI-88-216) Avail: NTIS HC A03/MF A01 CSCL 22A

The flight characteristics and spacecraft performance during missions involving flight between the equilateral libration points and the Moon are discussed. The conclusions drawn will show that a minimum energy trajectory is the most efficient transfer technique for this type of flight. Author

N89-15145*# Eagle Engineering, Inc., Houston, TX.
USER AND TECHNICAL DOCUMENTATION
30 Oct. 1988 100 p
(Contract NAS9-17878)
(NASA-CR-172100; NAS 1.26:172100; EEI-88-219) Avail: NTIS HC A05/MF A01 CSCL 22A

The program LP1 calculates outbound and return trajectories between low earth orbit (LEO) and libration point no. 1 (L1). Libration points (LP) are defined as locations in space that orbit the Earth such that they are always stationary with respect to the Earth-Moon line. L1 is located behind the Moon such that the pull of the Earth and Moon together just cancel the centrifugal acceleration associated with the libration point's orbit. The input required from the user to define the flight is described. The contents of the six reports produced as outputs are presented. Also included are the instructions needed to execute the program. Author

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

N89-15146# Materials Research Labs., Melbourne (Australia).
EXPERIMENTS WITH A SMALL INJECTED RAILGUN
D. F. Stainsby and D. R. Sadedin Jun. 1987 119 p
(MRL-R-1055; AR-005-134) Avail: NTIS HC A06/MF A01

Plasma arc and rail damage in railguns are described and discussed. The railgun body was constructed of clear polycarbonate to allow streak photographs of the plasma to be taken. A powder-gun injector was used to reduce initial rail damage. The development of the injector and projectiles is described. Rails with plain surfaces, alternating aluminum inserts, and lengthwise insulating stripes were studied. Both aluminum and copper foils were used for plasma initiation. The results from the experiments enable plasma formation to be explained in terms of the vaporization energy of the foil and material taken up from the bore. Magnetic pick-up coils were used to study plasma length and current distribution and the theory of the coils and a look-up table of calculated waveforms is given. A non-metallurgical study of rail damage has been made, and damage mechanisms identified. A qualitative model of the plasma is described, in which two current conduction modes at the rail-plasma boundary are identified. These are an ohmic (direct contact) mode, and an arc-root mode. The severe rail-surface damage observed is thought to be due to boundary conduction in the ohmic mode rather than to the current-carrying arc-roots leaving and entering the rails. Author

N89-15147# Lawrence Livermore National Lab., CA.
MECHANICAL BORE DAMAGE IN ROUND BORE COMPOSITE STRUCTURE RAILGUNS
A. R. Susoeff and R. S. Hawke 10 Feb. 1988 10 p
(Contract W-7405-eng-48)
(DE89-001285; UCID-21520) Avail: NTIS HC A03/MF A01

Some experiments conducted with composite structure round bore railguns at LLNL have resulted in the generation of mechanical bore damage. Various concepts to explain this phenomenon in terms of operational techniques or projectile properties have been brought forward. This paper discusses the use of various launcher materials, projectile designs, and describes the resultant damage as well as the measurement techniques used. Successful experiments were conducted by use of normal refurbishing techniques in spite of previous damage occurrence. An evolution of projectile design lead to the elimination of bore damage. DOE

N89-15608*# Rockwell International Corp., Huntsville, AL. Rocketdyne Div.
USING HYPERMEDIA TO DEVELOP AN INTELLIGENT TUTORIAL/DIAGNOSTIC SYSTEM FOR THE SPACE SHUTTLE MAIN ENGINE CONTROLLER LAB
Daniel OReilly, Robert Williams, and Kevin Yarborough *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 467-476 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 14B

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

No abstracts in this category.

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

N89-15148*# North Carolina State Univ., Raleigh. Dept. of Computer Science.
MICROCOMPUTER VERSUS MAINFRAME SIMULATIONS: A CASE STUDY Final Report
Neal M. Bengtson May 1988 49 p
(Grant NAG1-792)
(NASA-CR-184616; NAS 1.26:184616) Avail: NTIS HC A03/MF A01 CSCL 22B

The research was conducted to two parts. Part one consisted of a study of the feasibility of running the Space Transportation Model simulation on an office IBM-AT. The second part was to design simulation runs so as to study the effects of certain performance factors on the execution of the simulation model. The results of this research are given in the two reports which follow: Microcomputer vs. Mainframe Simulation: A Case Study and Fractional Factorial Designs of Simulation Runs for the Space Transportation System Operations Model. In the first part, a DOS batch job was written in order to simplify the execution of the simulation model on an office microcomputer. A comparison study was then performed of running the model on NASA-Langley's mainframe computer vs. running on the IBM-AT microcomputer. This was done in order to find the advantages and disadvantages of running the model on each machine with the objective of determining if running of the office PC was practical. The study concluded that it was. The large number of performance parameters in the Space Transportation model precluded running a full factorial design needed to determine the most significant design factors. The second report gives several suggested fractional factorial designs which require far fewer simulation runs in order to determine which factors have significant influence on results.

Author

N89-15149*# Battelle Columbus Labs., OH.
SPACE STATION LONG-TERM LUBRICATION ANALYSIS Monthly Progress Report, 1-30 Sep. 1985
K. F. Dufrane and E. E. Montgomery 15 Oct. 1985 7 p Prepared in cooperation with Spectra Research Systems, Inc., Huntsville, AL
(Contract NAS8-36655)
(NASA-CR-178882; NAS 1.26:178882) Avail: NTIS HC A02/MF A01 CSCL 22B

The objectives of this program are: (1) to perform a complete tribology survey of every point of contact in the space station subject to relative motion regarding the materials, environment, and operation characteristics, (2) to review each point of relative motion regarding the selected materials and lubricants from the standpoint of the required operating characteristics and environmental conditions, (3) to make recommendations for improvements where the lubricants and/or materials are not considered optimum, and (4) to perform or recommend simulated or full-scale tests on components where problems are possible or

likely because of new designs, significant design extensions beyond current practice, or sensitivity of other components to problems with a particular point of contact. The project is to be conducted over a 3-year time frame in two phases. Phase 1 will be a preliminary analysis conducted during the preliminary design phases of the Space Station. Phase 2 will be a more detailed analysis conducted during the period when the design becomes more established. Author

N89-15150*# Eagle Engineering, Inc., Houston, TX.
ADVANCED SPACE TRANSPORTATION SYSTEM SUPPORT CONTRACT Summary Final Report
30 Oct. 1988 75 p
(Contract NAS9-17878)
(NASA-CR-172104; NAS 1.26:172104; EEI-88-210) Avail: NTIS HC A04/MF A01 CSCL 22B

The general focus is on a phase 2 lunar base, or a lunar base during the period after the first return of a crew to the Moon, but before permanent occupancy. The software effort produced a series of trajectory programs covering low earth orbit (LEO) to various node locations, the node locations to the lunar surface, and then back to LEO. The surface operations study took a lunar scenario in the civil needs data base (CNDB) and attempted to estimate the amount of space-suit work or extravehicular activity (EVA) required to set up the base. The maintenance and supply options study was a first look at the problems of supplying and maintaining the base. A lunar surface launch and landing facility was conceptually designed. The lunar storm shelter study examined the problems of radiation protection. The lunar surface construction and equipment assembly study defined twenty surface construction and assembly tasks in detail. Author

17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

N89-15151*# National Aeronautics and Space Administration, Washington, DC.
CONSULTATIVE COMMITTEE FOR SPACE DATA SYSTEMS RECOMMENDATION FOR SPACE DATA SYSTEM STANDARDS: PACKET TELEMETRY
Jan. 1987 42 p Prepared in cooperation with CNES, Paris, France, DFVLR, Berlin, Fed. Republic of Germany, ESA, Paris, France, ISRO, Bangalore, India, INPE, Sao Jose dos Campos, Brazil and NASDA, Tokyo, Japan
(NASA-TM-101213; Blue-Book-Issue-2; CCSDS-102.0-B-2; NAS 1.15:101213) Avail: NASA, Washington, DC, Code TS CSCL 09F

A technical recommendation is presented for use in developing packetized telemetry systems. The Packet Telemetry concept described is the baseline concept for spacecraft-to-ground data communication within missions that are cross supported between agencies of the CCSDS. This recommendation establishes a common framework and provides a common basis for the data structures of spacecraft telemetry streams. It allows implementing organizations within each agency to proceed coherently with the development of compatible derived standards for the flight and ground systems that are within their cognizance. Derived agency standards may implement only a subset of the optional features allowed by the recommendation and may incorporate features not addressed by the recommendation. Author

N89-15152*# National Aeronautics and Space Administration, Washington, DC.
CONSULTATIVE COMMITTEE FOR SPACE DATA SYSTEMS RECOMMENDATION FOR SPACE DATA SYSTEM STANDARDS: TELEMETRY CHANNEL CODING
Jan. 1987 35 p Prepared in cooperation with CNES, Paris, France, DFVLR, Berlin, Fed. Republic of Germany, ESA, Paris, France, ISRO, Bangalore, India, INPE, Sao Jose dos Campos, Brazil and NASDA, Tokyo, Japan
(NASA-TM-101212; Blue-Book-Issue-2; CCSDS-101.0-B-2; NAS 1.15:101212) Avail: NASA, Washington, DC, Code TS CSCL 09F

A technical recommendation is presented for use in developing telemetry channel coding systems. The telemetry channel coding concept described is the baseline concept for spacecraft to ground data communication within missions that are cross supported between agencies of the CCSDS. This recommendation established a common framework and provides a common basis for the coding schemes used on spacecraft telemetry streams. It allows implementing organizations with each Agency to proceed coherently with the development of compatible derived standards for the flight and ground systems that are within their cognizance. Derived agency standards may implement only a subset of the optional features allowed by the recommendation and may incorporate features not addressed by the recommendation. Author

N89-15153*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
ATMOSPHERIC TRANSMISSION COEFFICIENTS FOR LASER PULSES WITH SPECTRAL WIDTHS OF A FEW TENTHS OF A NANOMETER OVER THE WAVELENGTH REGION FROM 800 TO 860 NANOMETERS
H. G. Safren Jul. 1988 18 p
(NASA-TM-100710; Rept-88B0265; NAS 1.15:100710) Avail: NTIS HC A03/MF A01 CSCL 09F

Effective atmospheric transmission spectra were calculated from 800 to 860 nanometers for laser sources with spectral widths of a few tenths of a nanometer. In this spectral region, the atmospheric absorption lines (water lines) have linewidths of a few hundredths of a nanometer, so that the transmission coefficient for a relatively wide laser pulse must be computed by taking a weighted average over the pulse spectral width. Laser spectral widths of several tenths of a nanometer are shown to reduce the effective absorption by water lines to as little as 10 to 20 percent, even when the laser is centered on a line or overlaps several lines. Thus, the effect of absorption by atmospheric water lines may be greatly reduced for laser communication systems using laser diode array transmitters, for which the pulse spectral width may be a few tenths of a nanometer. Author

N89-15595*# Technical Univ. of Denmark, Copenhagen. Electromagnetics Inst.
CONTROLLING BASINS OF ATTRACTION IN A NEURAL NETWORK-BASED TELEMETRY MONITOR
Benjamin Bell and James L. Eilbert (Grumman Aerospace Corp., Bethpage, NY.) *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 349-355 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09F

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

N89-15154*# Martin Marietta Aerospace, Denver, CO. Astronautics Group.
SPACE STATION INTEGRATED PROPULSION AND FLUID SYSTEMS STUDY Final Report
B. Bicknell, S. Wilson, M. Dennis, D. Shepard, and R. Rossier

Sep. 1988 106 p
(Contract NAS8-36438)
(NASA-CR-183509; NAS 1.26:183509; MCR-88-539) Avail: NTIS HC A06/MF A01 CSCL 22B

The program study was performed in two tasks: Task 1 addressed propulsion systems and Task 2 addressed all fluid systems associated with the Space Station elements, which also included propulsion and pressurant systems. Program results indicated a substantial reduction in life cycle costs through integrating the oxygen/hydrogen propulsion system with the environmental control and life support system, and through supplying nitrogen in a cryogenic gaseous supercritical or subcritical liquid state. A water sensitivity analysis showed that increasing the food water content would substantially increase the amount of water available for propulsion use and in all cases, the implementation of the BOSCH CO2 reduction process would reduce overall life cycle costs to the station and minimize risk. An investigation of fluid systems and associated requirements revealed a delicate balance between the individual propulsion and fluid systems across work packages and a strong interdependence between all other fluid systems. Author

N89-15155*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
EXPERIENCES IN APPLYING OPTIMIZATION TECHNIQUES TO CONFIGURATIONS FOR THE CONTROL OF FLEXIBLE STRUCTURES (COFS) PROGRAM
Joanne L. Walsh Oct. 1988 31 p Presented at the 2nd NASA/Air Force Symposium on Recent Advances in Multidisciplinary Analysis and Optimization, Hampton, VA, 28-30 Sep. 1988
(NASA-TM-101511; NAS 1.15:101511) Avail: NTIS HC A03/MF A01 CSCL 22B

Optimization procedures are developed to systematically provide closely-spaced vibration frequencies. A general-purpose finite-element program for eigenvalue and sensitivity analyses is combined with formal mathematical programming techniques. Results are presented for three studies. The first study uses a simple model to obtain a design with two pairs of closely-spaced frequencies. Two formulations are developed: an objective function-based formulation and constraint-based formulation for the frequency spacing. It is found that conflicting goals are handled better by a constraint-based formulation. The second study uses a detailed model to obtain a design with one pair of closely-spaced frequencies while satisfying requirements on local member frequencies and manufacturing tolerances. Two formulations are developed. Both the constraint-based and the objective function-based formulations perform reasonably well and converge to the same results. However, no feasible design solution exists which satisfies all design requirements for the choices of design variables and the upper and lower design variable values used. More design freedom is needed to achieve a fully satisfactory design. The third study is part of a redesign activity in which a detailed model is used. The use of optimization in this activity allows investigation of numerous options (such as number of bays, material, minimum diagonal wall thicknesses) in a relatively short time. The procedure provides data for judgments on the effects of different options on the design. Author

N89-15156# General Analytic Corp., Athens, GA.
A NEW APPROACH TO THE ANALYSIS AND CONTROL OF LARGE SPACE STRUCTURES, PHASE 1 Final Report, 15 Oct. 1987 - 14 Mar. 1988
George Adomian 12 Mar. 1988 129 p
(Contract F49620-87-C-0098)
(AD-A198143; GAC-881; AFOSR-88-0702TR) Avail: NTIS HC A07/MF A01 CSCL 22E

The large structures contemplated would be constructed in space. Because of the limitations on launching massive payloads, it is clear that these structures will be made of lightweight material and will necessarily be flexible and easily excited into vibrations. Analytical problems will arise in designing large space structures in which physically realistic and accurate solutions will be critical. Such designs must consider weight, sizes, stiffness, thermal and mechanical distortions, stresses due to gravity and positioning thrusts. Some specific analytical problems will involve vibration, heating and cooling, multidimensional control, and structural problems arising from random support motion and random fluctuations of the system dynamic properties. GRA

N89-15157*# Eagle Engineering, Inc., Houston, TX.
LANDER PROGRAM MANUAL: A LUNAR ASCENT AND DESCENT SIMULATION
30 Sep. 1988 88 p
(Contract NAS9-17878)
(NASA-CR-172088; NAS 1.26:172088; EEI-88-195) Avail: NTIS HC A05/MF A01 CSCL 22B

LANDER is a computer program used to predict the trajectory and flight performance of a spacecraft ascending or descending between a low lunar orbit of 15 to 500 nautical miles (nm) and the lunar surface. It is a three degree-of-freedom simulation which is used to analyze the translational motion of the vehicle during descent. Attitude dynamics and rotational motion are not considered. The program can be used to simulate either an ascent from the Moon or a descent to the Moon. For an ascent, the spacecraft is initialized at the lunar surface and accelerates vertically away from the ground at full thrust. When the local velocity becomes 30 ft/s, the vehicle turns downrange with a pitch-over maneuver and proceeds to fly a gravity turn until Main Engine Cutoff (MECO). The spacecraft then coasts until it reaches the requested holding orbit where it performs an orbital insertion burn. During a descent simulation, the lander begins in the holding orbit and performs a deorbit burn. It then coasts to pericynthion, where it reignites its engines and begins a gravity turn descent. When the local horizontal velocity becomes zero, the lander pitches up to a vertical orientation and begins to hover in search of a landing site. The lander hovers for a period of time specified by the user, and then lands. Author

N89-15158# Air Force Geophysics Lab., Hanscom AFB, MA.
A CHARGE CONTROL SYSTEM FOR SPACECRAFT PROTECTION
B. M. Shuman, H. A. Cohen, J. Hyman, R. R. Robson, and W. S. Williamson (Hughes Research Labs., Malibu, CA.) 26 Sep. 1988 16 p
(AF Proj. 2823)
(AD-A199904; AFGL-TR-88-0246) Avail: NTIS HC A03/MF A01 CSCL 22A

An autonomous system to detect both absolute and differential spacecraft charging aboard high altitude satellites, and to reduce those potentials before hazardous arcing levels are reached, is now being developed. Operation of the system is based on the empirical results of the Space Test Program SCATHA (p78-2) and NASA ATS-6 satellites, both of which successfully demonstrated the principle of safely reducing spacecraft charging levels by the emission of a low energy neutral plasma--effectively shorting the spacecraft and charged dielectric surfaces to the ambient space plasma. The Charge Control System will utilize a xenon-based plasma source capable of igniting within one second, and capable of emitting a quasi-neutral plasma containing more than 1 MA of ions. Satellite frame potential (relative to the ambient space plasma) will be determined by an electrostatic analyzer capable of detecting both ions and electrons in the energy range 50 eV to 20 keV. Automatic operation of the system will accomplished by microprocessor controller which will interpret the sensor data and activate the plasma source when predetermined threshold levels are exceeded. With a gas supply for more than 2000 hours of operation in space, the system may be expected to provide on-orbit spacecraft protection for up to 10 years. GRA

N89-15159# Sandia National Labs., Albuquerque, NM.
EXPERIMENTAL OBSERVATIONS OF LOW AND ZERO GRAVITY NONLINEAR FLUID-SPACECRAFT INTERACTION
L. D. Peterson 1988 24 p Presented at the 59th Shock and Vibration Symposium, Albuquerque, NM, 18 Oct. 1988

(Contract DE-AC04-76DP-00789)
(DE88-015263; SAND-88-1520C; CONF-881076-6) Avail: NTIS HC A03/MF A01

Low and zero gravity simulation experiments of the motion of a spacecraft coupled to the nonlinear slosh of a contained fluid are presented and discussed. A generic study model, in which a linear, spring-mass-damper spacecraft mode was coupled to the slosh of a fluid within an attached cylinder, has been studied experimentally using a unique, scale model apparatus. Low gravity was simulated in a 1 g laboratory using capillary (Bond number) scaled models, and zero gravity was simulated during experiments on the NASA KC-135 Reduced Gravity Test Facility. The mass fraction of fluid, the tuning ratio of the fluid and spacecraft vibrations, the spacecraft damping ratio, and the nondimensional gravity level were systematically varied. The nonlinear free decay response of the experimental systems exhibited system natural frequencies which varied in proportion to the square of the amplitude of the motion. The nonlinear resonance responses displayed harmonic, nonharmonic, planar, nonplanar, and spatially chaotic motions. These experimental responses can only be modeled by a nonlinear analytical model of the fluid coupled to the spacecraft model, and cannot be predicted by the simple linear slosh models now in use. DOE

N89-15160# European Space Agency, Paris (France).
DESIGN, SIMULATION AND LABORATORY TEST OF AN INERTIAL SYSTEM FOR MEASURING THE ATTITUDE AND NARROW-SPACED MOTIONS
Bernhard Steiler, Egmar Luebeck, and Volker Wetzig (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick, Germany, F.R.) Nov. 1988 196 p Transl. into ENGLISH of Ausleng, Simulation und Laborerprobung eines Interialsystems zur Vermessung der Winkellage und Kleinraeumiger Bewegungsablaeufe (Brunswick, Fed. Republic of Germany, DFVLR) Original language document was announced as N88-21426
(ESA-TT-1104; DFVLR-FB-87-42; ETN-89-93906) Avail: NTIS HC A09/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 62 Deutsche marks

A system for accurately measuring the attitude of an aircraft model under dynamic conditions in a wind tunnel was developed. Accuracy is within 0.03 deg using strapdown sensors of limited quality. The system also allows accurate measurement of fast narrow-spaced motions. Sensor errors are calibrated while the system is at rest, and their constant part is compensated during the measurement phase. ESA

N89-15161 Missouri Univ., Rolla.
MODELING AND CONTROL OF LARGE FLEXIBLE SPACE STRUCTURES Ph.D. Thesis
Jayant V. Ramakrishnan 1988 230 p
Avail: Univ. Microfilms Order No. DA8816024

Simulation of space structures forms a critical part of the space station design process. The distributed parameter system is discretized by the finite element technique and represented by a finite set of ordinary differential equations. However, from the viewpoint of control computations, the dimensions of the finite element matrices are too large. A lower order model based on some criteria is derived via the process of aggregation and is used for simulation purposes. The thesis investigates the merits and demerits of some model reduction techniques as addressed to this specific problem. A simple and intuitively appealing degree-of-controllability definition is derived that enhances the approach to the actuator/sensor placement problem. Controller synthesis for a realistic space station, the associated spillover, bounds of suboptimality and the performance degradation are investigated. The balanced realization technique and the Routh approximation method are used in the synthesis of lower order models. The simulations include vibration suppression and minimization of line-of-sight errors. Results indicate that controllers derived using reduced order models perform very well.
Dissert. Abstr.

N89-15162*# Ball Corp., Boulder, CO. Space Systems Div.
ELECTRODYNAMIC TETHER SYSTEM STUDY: EXTENDED STUDY Final Report
Sep. 1988 52 p
(Contract NAS9-17666)
(NASA-CR-172115; NAS 1.26:172115) Avail: NTIS HC A04/MF A01 CSCL 22B

This document is the final report of a study performed by Ball Space Systems Division (BSSD) for the NASA Johnson Space Center under an extension to contract NAS9-17666. The tasks for the extended study were as follows: (1) Define an interface between the Electrodynamic Tether System (ETS) and the Space Station (SS); (2) Identify growth paths for the 100 kW ETS defined in the original study to a 200 kW level of performance; (3) Quantify orbit perturbations caused by cyclic day/night operations of a Plasma Motor/Generator (PMG) on the SS and explore methods of minimizing these effects; (4) Define the analyses, precursor technology, ground tests, and precursor demonstrations leading up to a demonstration mission for an electrodynamic tether system that would be capable of producing maneuvering thrust levels of 25 newtons; and (5) Propose a development schedule for the demonstration mission and preliminary cost estimates. Author

N89-15163*# California Univ., Los Angeles.
A MATHEMATICAL FORMULATION OF THE SCOLE CONTROL PROBLEM. PART 2: OPTIMAL COMPENSATOR DESIGN Final Report
A. V. Balakrishnan Dec. 1988 24 p
(Grant NAG1-464)
(NASA-CR-181720; NAS 1.26:181720) Avail: NTIS HC A03/MF A01 CSCL 22B

The study initiated in Part 1 of this report is concluded and optimal feedback control (compensator) design for stability augmentation is considered, following the mathematical formulation developed in Part 1. Co-located (rate) sensors and (force and moment) actuators are assumed, and allowing for both sensor and actuator noise, stabilization is formulated as a stochastic regulator problem. Specializing the general theory developed by the author, a complete, closed form solution (believed to be new with this report) is obtained, taking advantage of the fact that the inherent structural damping is light. In particular, it is possible to solve in closed form the associated infinite-dimensional steady-state Riccati equations. The SCOLE model involves associated partial differential equations in a single space variable, but the compensator design theory developed is far more general since it is given in the abstract wave equation formulation. The results thus hold for any multibody system so long as the basic model is linear. Author

N89-15576*# Rockwell International Corp., Seal Beach, CA. Satellite and Space Electronics Div.
EXPERT SYSTEM FOR ON-BOARD SATELLITE SCHEDULING AND CONTROL
John M. Barry and Charisse Sary *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 193-203 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 22B

N89-15584*# Rockwell International Corp., Downey, CA. Space Transportation Systems Div.
SUCCESSFUL EXPERT SYSTEMS FOR SPACE SHUTTLE PAYLOAD INTEGRATION
Keith Morris *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 245-252 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 22B

N89-15607*# Aerospace Corp., Los Angeles, CA. Space Sciences Lab.
SPACECRAFT ENVIRONMENTAL ANOMALIES EXPERT SYSTEM

H. C. Koons and D. J. Gorney *In* NASA, Marshall Space Flight Center, Foruth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 457-465 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 22B

N89-15791*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SUMMARY OF REQUIREMENTS IN NASA WORK PACKAGE NO. 2
L. Leger and H. Ehlers *In* NASA, Marshall Space Flight Center, Space Station Induced Monitoring Nov. 1988 p 1-4 (For primary document see N89-15790 07-88)
Avail: NTIS HC A05/MF A01 CSCL 22B

N89-15792*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
ENVIRONMENTAL MONITORING FOR SPACE STATION WP01
J. M. Zwiener *In its* Space Station Induced Monitoring Nov. 1988 p 5-12 (For primary document see N89-15790 07-88)
Avail: NTIS HC A05/MF A01 CSCL 22B

N89-15793*# TS Infosystems, Lanham, MD.
GSFC CONTAMINATION MONITORS FOR SPACE STATION
P. A. Carosso, J. L. Tveekrem, and J. D. Coopersmith *In* NASA, Marshall Space Flight Center, Space Station Induced Monitoring Nov. 1988 p 13-17 (For primary document see N89-15790 07-88)
Avail: NTIS HC A05/MF A01 CSCL 22B

N89-15794*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
PLASMA INTERACTIONS MONITORING SYSTEM
William T. Roberts *In its* Space Station Induced Monitoring Nov. 1988 p 19-25 (For primary document see N89-15790 07-88)
Avail: NTIS HC A05/MF A01 CSCL 22B

N89-15795*# Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
THE SPACE STATION NEUTRAL GAS ENVIRONMENT AND THE CONCOMITANT REQUIREMENTS FOR MONITORING
George Carignan *In* NASA, Marshall Space Flight Center, Space Station Induced Monitoring Nov. 1988 p 27-28 (For primary document see N89-15790 07-88)
Avail: NTIS HC A05/MF A01 CSCL 22B

N89-15796*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
A COMPACT IMAGING SPECTROMETER FOR STUDIES OF SPACE VEHICLE INDUCED ENVIRONMENT EMISSIONS
Marsha R. Torr, ed. and D. G. Torr (Alabama Univ., Huntsville.) *In its* Space Station Induced Monitoring Nov. 1988 p 31-38 (For primary document see N89-15790 07-88)
Avail: NTIS HC A05/MF A01 CSCL 22B

N89-15797*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
INFRARED MONITORING OF THE SPACE STATION ENVIRONMENT
Theodor Kostiuk, Donald E. Jennings, and Michael J. Mumma *In* NASA, Marshall Space Flight Center, Space Station Induced Monitoring Nov. 1988 p 39-46 (For primary document see N89-15790 07-88)
Avail: NTIS HC A05/MF A01 CSCL 22B

N89-15798*# Physical Sciences, Inc., Andover, MA. Applied Sciences.
REQUIREMENTS FOR PARTICULATE MONITORING SYSTEM FOR SPACE STATION
Byron David Green *In* NASA, Marshall Space Flight Center, Space Station Induced Monitoring Nov. 1988 p 47-49 (For primary document see N89-15790 07-88)
Avail: NTIS HC A05/MF A01 CSCL 22B

N89-15799*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
SPACE STATION SURFACE DEPOSITION MONITORING
E. R. Miller *In its* Space Station Induced Monitoring Nov. 1988 p 51-57 (For primary document see N89-15790 07-88)
Avail: NTIS HC A05/MF A01 CSCL 22B

N89-15800*# Science and Engineering Associates, Inc., Englewood, CO.
CONTAMINATION CONTROL REQUIREMENTS DOCUMENT JSC 30426 RECOMMENDED UPDATES
Ray Rantanen *In* NASA, Marshall Space Flight Center, Space Station Induced Monitoring Nov. 1988 p 59-69 (For primary document see N89-15790 07-88)
Avail: NTIS HC A05/MF A01 CSCL 22B

N89-15801*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
DISPOSITION OF RECOMMENDED MODIFICATIONS OF JSC 30426
James F. Spann, ed. *In its* Space Station Induced Monitoring Nov. 1988 p 71-76 (For primary document see N89-15790 07-88)
Avail: NTIS HC A05/MF A01 CSCL 22B

N89-15802*# Alabama Univ., Huntsville. Dept. of Electrical and Computer Engineering.
ARCING AND DISCHARGES IN HIGH-VOLTAGE SUBSYSTEMS OF SPACE STATION
N. Singh *In* NASA, Marshall Space Flight Center, Space Station Induced Monitoring Nov. 1988 p 77-81 (For primary document see N89-15790 07-88)
Avail: NTIS HC A05/MF A01 CSCL 22B

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

N89-15596*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
AN EXPERT SYSTEM FOR SATELLITE AND INSTRUMENT DATA ANOMALY AND FAULT ISOLATION
Carl Busse *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 356-367 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 14B

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxilliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

N89-15164*# Rockwell International Corp., Canoga Park, CA. Rocketdyne Div.
SPACE STATION WP-04 POWER SYSTEM PRELIMINARY ANALYSIS AND DESIGN DOCUMENT, VOLUME 3
19 Dec. 1986 372 p
(Contract NAS3-24666)
(NASA-CR-179587-Vol-3; NAS 1.26:179587-Vol-3; RI/RD85-320-2-Vol-3) Avail: NTIS HC A16/MF A01 CSCL 10B

Rocketdyne plans to generate a system level specification for the Space Station Electric Power System (EPS) in order to facilitate the usage, accountability, and tracking of overall system level

requirements. The origins and status of the verification planning effort are traced and an overview of the Space Station program interactions are provided. The work package level interfaces between the EPS and the other Space Station work packages are outlined. A trade study was performed to determine the peaking split between PV and SD, and specifically to compare the inherent total peaking capability with proportionally shared peaking. In order to determine EPS cost drivers for the previous submittal of DRO2, the life cycle cost (LCC) model was run to identify the more significant costs and the factors contributing to them. B.G.

N89-15165# Sandia National Labs., Albuquerque, NM. Applied Mechanics Div. 4.
RIBS: RIGID BODY SIMULATION OF THE MOTION OF TWO STAGES IN A BOOSTER SYSTEM
Clark R. Dohrmann Aug. 1988 41 p
(Contract DE-AC04-76DP-00789)
(DE89-001278; SAND-88-1305) Avail: NTIS HC A03/MF A01

A method for simulating the motion of two stages in a booster system is described. The analysis of the motion considers both the separation and independent motion of the two stages. During separation, the stages may be pushed apart through a combination of thrusters and springs. A guide which is assumed frictionless and in perfect sliding contact partially restricts relative motion between the stages during separation. Throughout the motion, time-dependent forces that are specified beforehand may be applied to either of the stages. Equations of motion are numerically integrated in the computer program RIBS, which may be used to assist in the evaluation of different designs and deployment options. The input file and output options for RIBS are described in detail in this report and example problems provided. DOE

N89-15166*# Alabama A & M Univ., Normal.
STATISTICAL ANALYSIS OF SSME SYSTEM DATA
Enoch C. Temple and Jerry R. Shipman 24 Oct. 1988 14 p
(Grant NAG8-042)
(NASA-CR-184650; NAS 1.26:184650) Avail: NTIS HC A03/MF A01 CSCL 21H

A statistical methodology to enhance the Space Shuttle Main Engine (SSME) performance prediction accuracy is proposed. This methodology was to be used in conjunction with existing SSME performance prediction computer codes to improve parameter prediction accuracy and to quantify that accuracy. However, after a review of related literature, researchers concluded that the proposed problem required a coverage of areas such as linear and nonlinear system theory, measurement theory, statistics, and stochastic estimation. Since state space theory is the foundation for a more complete study of each of the before mentioned areas, these researchers chose to refocus emphasis to cover the more specialized topic of state vector estimation procedures. State vector estimation was also selected because of current and future concerns by NASA for SSME performance evaluation; i.e., there is a current interest in an improved evaluation procedure for actual SSME post flight performance as well as for post static test performance of a single SSME. A current investigation of analytical methods may be used to improve test stand failure detection. This paper considers the issue of post flight/test state variable reconstruction through the application of observations made on the output of the Space Shuttle propulsion system. Rogers used the Kalman filtering procedure to reconstruct the state variables of the Space Shuttle propulsion system. An objective of this paper is to give the general setup of the Kalman filter and its connection to linear regression. A second objective is to examine the reconstruction methodology for application to the reconstruction of the state vector of a single Space Shuttle Main Engine (SSME) by using static test firing data. Author

N89-15167*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
ASSESSMENT OF THE HYDROGEN EXTERNAL TANK PRESSURE DECAY ANOMALY ON SPACE TRANSPORTATION SYSTEM (STS) 51-L
Theresa M. Buckley Sep. 1988 93 p
(NASA-TM-100462; S-574; NAS 1.15:100462) Avail: NTIS HC A05/MF A01 CSCL 21H

Following the Challenger tragedy, an evaluation of the integrated main propulsion system flight data revealed a premature decay in the hydrogen external tank ullage pressure. A reconstruction of predicted ullage pressure versus time indicated an inconsistency between predicted and measured ullage pressure starting at approximately 65.5 seconds into the flight and reaching a maximum value between 72 and 72.9 seconds. This discrepancy could have been caused by a hydrogen gas leak or by a liquied hydrogen leak that occurred either in the pressurization system or in the external tank. The corresponding leak rates over the time interval from 65.5 to 72.9 seconds were estimated to range from 0.28 kg/s (0.62 lbm/s) + or - 41 percent to between 0.43 and 0.51kg/s (0.94 and 1.12lbs/s) + or - 1 percent for a gas leak and from 72.9 kg/s (160.5 lbs/s) + or - 41 percent to between 111.6 and 133.2 kg/s (245.8 and 293.3 lbs/s) + or - 1 percent for a liquid leak. No speculation is made to ascertain whether the leak is liquid or gas, as this cannot be determined from the analysis performed. Four structural failures in the hydrogen external tank were considered to explain the leak rates. A break in the 5-cm (2 in) pressurization line, in the 13-cm (5 in) vent line, or in the 43-cm (17 in) feedline is not likely. A break in the 10-cm (4 in) recirculation line with a larger structural failure occurring in the 72 to 73-second time period, the time of the visibly identified premature pressure decay, does seem plausible and the most likely of the four modes considered. These modes are not all-inclusive and do not preclude the possibility of a leak elsewhere in the tank. Author

N89-15168# Aerospace Industries Association of America, Inc., Washington, DC. Rocket Propulsion Committee.
A DETAILED TECHNOLOGY ROADMAP FOR ROCKET PROPULSION
1 Oct. 1988 76 p
Avail: NTIS HC A05/MF A01

The Aerospaces Industries Association (AIA) initiative, called Key Technologies for the 1990's, proposes a three-pronged national strategy with the goal of ensuring U.S. technological superiority in aerospace products and military capability well into the 21st century. The first element of this effort is to create a cooperative national effort among industry, government, and academia to focus on the development of selected key technologies. The second is to cooperatively mold innovative policies that will stimulate technology development and facilitate its rapid application to new commercial and military products. The third element will focus on development of methodologies, tools, and disciplines required to increase the competitive advantage of our technology base. AIA is committed to a leadership role, working cooperatively with government and universities. Author

N89-15169*# Texas Univ., Austin. Dept. of Mechanical Engineering.
INVESTIGATION OF ENERGY TRANSFER IN THE IGNITION MECHANISM OF A NASA STANDARD INITIATOR Final Technical Report, 1 Feb. 1987 - 1 Aug. 1988
Philip L. Varghese 1988 31 p
(Grant NAG9-201)
(NASA-CR-184673; NAS 1.26:184673) Avail: NTIS HC A03/MF A01 CSCL 21H

The principal objective of the proposed research was to construct a detailed computer model of the NASA Standard Initiator (NSI). The NSI plays a critical role in initiating various pyrotechnic events in the National Space Transportation System and is also used in Shuttle payload applications. Several initiators failed when being tested at very low temperatures (4 to 20 K). During subsequent investigation an unacceptable high failure rate was found even at higher temperatures (100 to 150 K) but the precise cause of failure was not determined. The modelling work was undertaken to investigate reasons for failure and to predict the performance of alternate firing schemes. The work has shown that the most likely cause of failure at low temperature is poor

thermal contact between the electrically heated bridgewire and the pyrotechnic charge. This problem may be masked if there is good thermal contact between the bridgewire and the alumina charge cup. The high thermal conductivity of alumina at cryogenic temperatures was overlooked in previous analyses, which assumed that the charge cup acted as a thermal insulator. Author

N89-15170*# Ohio State Univ., Columbus. Dept. of Aeronautical and Astronautical Engineering.
THE EFFECTS OF MAGNETIC NOZZLE CONFIGURATIONS ON PLASMA THRUSTERS Semiannual Progress Report, 30 Jun. - 31 Dec. 1988
Thomas M. York 25 Jan. 1989 57 p
(Grant NAG3-843)
(NASA-CR-184678; NAS 1.26:184678; AAE-AARL-P-89-1) Avail: NTIS HC A04/MF A01 CSCL 21C

Plasma thrusters have been operated at power levels from 10kW to 0.1MW. When these devices have had magnetic fields applied to them which form a nozzle configuration for the expanding plasma, they have shown marked increases in exhaust velocity which is in direct proportion to the magnitude of the applied field. Further, recent results have shown that electrode erosion may be influenced by applied magnetic fields. This research is directed to the experimental and computational study of the effects of applied magnetic field nozzles in the acceleration of plasma flows. Plasma source devices which eliminate the plasma interaction in normal thrusters are studied as most basic. Normal thruster configurations will be studied without applied fields and with applied magnetic nozzle fields. Unique computational studies will utilize existing codes which accurately include transport processes. Unique diagnostic studies will support the experimental studies to generate new data. Both computation and diagnostics will be combined to indicate the physical mechanisms and transport properties that are operative in order to allow scaling and accurate prediction of thruster performance. Author

N89-15171*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ISSUES AND OPPORTUNITIES IN SPACE PHOTOVOLTAICS
Robert W. Francis, W. A. Somerville (Aerospace Corp., El Segundo, CA.), and Dennis J. Flood 1988 14 p Presented at the 20th Photovoltaic Specialists Conference, Las Vegas, NV, 26-30 Sep. 1988; sponsored by the Institute of Electrical and Electronics Engineers
(NASA-TM-101425; E-4526; NAS 1.15:101425) Avail: NTIS HC A03/MF A01 CSCL 10B

Space power sources are becoming a central focus for determining man's potential and schedule for exploring and utilizing the benefits of space. The ability to search, probe, survey, and communicate throughout the universe will depend on providing adequate power to the instruments to do these jobs. Power requirements for space platforms are increasing and will continue to increase into the 21st century. Photovoltaics have been a dependable power source for space for the last 30 years and have served as the primary source of power on virtually all DOD and NASA satellites. The performance of silicon (Si) solar cells has increased from 10 percent air mass zero (AM0) solar energy conversion efficiency in the early 60's to almost 15 percent on today's spacecraft. Some technologists even think that the potential for solar photovoltaics has reached a plateau. However, present and near-future Air Force and NASA requirements show needs that, if the problems are looked upon as opportunities, can elevate the photovoltaic power source scientist and array structure engineer into the next technological photovoltaic growth curve. Author

N89-15579*# Case Western Reserve Univ., Cleveland, OH. Dept. of Computer Engineering and Science.
A CLIPS PROTOTYPE FOR AUTONOMOUS POWER SYSTEM CONTROL
James M. Vezina and Leon Sterling *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 211-220 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 21H

N89-15606*# Furman Univ., Greenville, SC.
USE OF AN EXPERT SYSTEM DATA ANALYSIS MANAGER FOR SPACE SHUTTLE MAIN ENGINE TEST EVALUATION
Ken Abernethy *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 451-456 (For primary document see N89-15549 07-61)
(Grant NAG8-646)
Avail: NTIS HC A21/MF A01 CSCL 21H

23 CHEMISTRY AND MATERIALS (GENERAL)

N89-15172# Washington Univ., Seattle. Dept. of Materials Science and Engineering.
THE DESIGN, ACTIVATION AND SELECTIVE TRANSFORMATION OF ORGANOMETALLIC COMPOUNDS INTO COMMON AND EXOTIC MATERIALS
Richard M. Laine, Bernard J. Aylett, Jacques Livage, Donald Schleich, and Robert J. Corriu Sep. 1988 27 p
(Contract N00014-88-K-0305)
(AD-A199401; TR-16) Avail: NTIS HC A03/MF A01 CSCL 07A

Future directions in Materials Chemistry research are identified based on the NATO/ONR Advanced Research Workshop, The Design, Activation and Selective Transformation of Organometallic Compounds into Common and Exotic Materials. Specific problems and research needs in the fields of: (1) Premetallic and preceramic organometallics; (2) Chemical Vapor deposition precursors; and, (3) Sol-gel chemistry are discussed. Fundamental problems at the interfaces of chemistry, physics, and materials science are also considered. GRA

24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.
For ceramic materials see *27 Nonmetallic Materials.*

N89-15173 Purdue Univ., West Lafayette, IN.
EFFECT OF BENDING-EXTENSION COUPLING ON THE DEFORMATION OF ASYMMETRIC LAMINATES Ph.D. Thesis
Hsiang Chin 1987 179 p
Avail: Univ. Microfilms Order No. DA8807595

Asymmetric laminates may result from delamination and surface damage in symmetric laminates. Linear small deflection laminated plate theory, large deflection theory, and finite element method were used to investigate the behavior of asymmetric crossply laminates subjected to in-plane loads and transverse loads. The behavior of asymmetric laminates subjected to uniform compression loads and the fundamental frequency of asymmetric laminates with small and large amplitudes were studied. A simple solution was introduced to solve the problem using large deflection theory to correct the deficiency of linear theory. It was shown that for the cylindrical bending problem, the governing equations for large deflection theory could be reduced to linear equations with nonlinear boundary conditions. A finite element plate program based upon Mindlin plate theory and von Karman's large deflection theory were also used to analyze the asymmetric laminated plate. Experiments on crossply laminates under in-plane loads were conducted. In recent studies, effects of bending-extension coupling on the deformation of asymmetric laminates were symmetrically studied to observe problems related to the axial forces, transverse forces, compression forces, and nonlinear and linear vibrations. The results of these studies may provide a basis for further

understanding the mechanism of delamination and for analyzing the failure of composite structures. Dissert. Abstr.

N89-15174# Bureau of Mines, Albany, OR. Research Center.
EFFECTS OF COMPOSITION AND PROCESSING VARIABLES ON TRANSVERSE RUPTURE STRENGTH AND HARDNESS OF NICKEL-ALLOY-BONDED TITANIUM CARBIDE: REPORT OF INVESTIGATIONS/1987
George T. Fisher, II, Laurance Oden, L., and Gene Asai 1987 32 p
(PB88-232137; BM-RI-9115; LC-87-600030) Avail: NTIS HC A03/MF A01 CSCL 11D

Substitute materials, based on Ni-alloy-bonded TiC, were investigated for C-5-grade cutting tool applications. The substitution would result in less dependence on foreign sources for Co, Ta, and W, and use of lower cost materials. The effects of composition and processing variables on the transverse rupture strength and hardness of Ni-alloy-bonded TiC were studied to identify compositions that exhibit promising mechanical properties. Compositions for evaluation were prepared by a powder metallurgy method of cold pressing and liquid phase sintering. Complementary analysis of compositions included chemical analysis, X-ray diffraction, energy dispersive X-ray spectroscopy, and density measurements. Author

N89-15175# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Metallurgical Engineering and Materials Science.
FUNDAMENTALS OF INTERFACIAL STRENGTH IN COMPOSITE MATERIALS Annual Report No. 1, 1 Jul. 1986 - 30 Sep. 1987
A. W. Thompson, I. M. Bernstein, and A. Voelkel 16 Nov. 1987 22 p
(Grant AF-AFOSR-0238-86; AF Proj. 2306)
(AD-A198626; MEMS-ALC-14; AFOSR-88-0769TR) Avail: NTIS HC A03/MF A01 CSCL 11D

The current research period has emphasized 6061 and 7090 aluminum alloys as composite matrices, both with particulate SiC reinforcements. As in previous work, the fracture behavior is found to be sensitive to both process variables (i.e., different consolidation methods by the two material producers) and to metallurgical variables (i.e., degree of aging). In particular, overaging these materials leads to precipitation at the interface between the matrix and the SiC, which in turn appears to encourage initiation and growth of microvoids at those interfaces, leading to enhanced ductile fracture. GRA

N89-15176# Martin Marietta Aerospace, Denver, CO. Astronautics Group.
DAMPING CHARACTERISTICS OF METAL MATRIX COMPOSITES Quarterly Letter Progress Report No. 9, 11 Apr. - 10 Aug. 1988
Mohan S. Misra 10 Aug. 1988 9 p
(Contract N00014-85-C-0857)
(AD-A200004; MCR-85-721-9) Avail: NTIS HC A02/MF A01 CSCL 11D

Metal matrix composites (MMC) with enhanced material damping can be potential structural materials to improve significantly the stability, control and reliability of space structures. Objectives of this investigation are: identify the mechanisms and sources of damping in continuous fiber-reinforced MMC (Gr/Al and Gr/Mg) using in situ characterization techniques, determine the role of microstructural parameters (fiber volume, fiber orientation; interfiber spacing, grain size, precipitate morphology) in damping; define the role of the fiber-matrix interface in damping; and develop high damping structural materials for space applications. GRA

N89-15177# Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
STRESS-STRAIN PROPERTIES OF SIFCON IN UNIAXIAL COMPRESSION AND TENSION Final Report, 29 May 1985 - 30 Oct. 1987
Joseph R. Homrich and Antoine E. Naaman Aug. 1988 148 p
(Contract F29601-85-K-0069)
(AD-A199179; AFWL-TR-87-115) Avail: NTIS HC A07/MF A01 CSCL 11D

This report presents a comprehensive investigation of the properties of SIFCON composites in both uniaxial compression and uniaxial tension, as well as their stress-displacement response in tension. The importance of the primary reinforcing parameters such as fiber type, fiber orientation, matrix properties, and matrix penetration of the fiber network is highlighted. Test results indicate that very high compressive strengths (up to 20 k/sq in or 140 MPa) can be achieved and compressive strains of up to 10 percent can be expected at about half the strength. Similarly, high tensile strengths (up to 4 k/sq in or 28 MPa) with strains of up to 2 percent accompanied by extensive multiple cracking were also observed. Surface energies and toughness indexes in tension reached about three orders of magnitude above those known for plain concrete. The toughness of SIFCON in compression computed at 10 percent strain was up to 50 times that of plain concrete. Analytical models are proposed to predict the stress-strain response of SIFCON in both compression and tension as well as its stress-crack opening response in tension. GRA

N89-15178# Purdue Univ., West Lafayette, IN. Composite Materials Lab.
MECHANICAL PROPERTIES OF GRAPHITE/EPOXY COMPOSITES AT VARIOUS TEMPERATURES Technical Report, 30 Mar. - 30 Oct. 1987
C. T. Sun and K. J. Yoon Jan. 1988 34 p
(Contracts DLA900-86-C-0751; MIPR-87-617)
(AD-A199311; HTMIAC-9) Avail: NTIS HC A03/MF A01 CSCL 11D

Off-axis tension tests were performed for coupon specimens of unidirectional graphite/epoxy composites at various temperatures. Elastic moduli and principal strengths of the composite were obtained by a simple procedure. To avoid the complication caused by the extension-shear coupling effect in off-axis testing, a new tab was designed and used on the test specimens. Excellent results for tensile modulus, tensile strength, shear modulus, shear strength, and Poisson's ratio were obtained. GRA

N89-15179# Argonne National Lab., IL. Materials and Components Technology Div.
NEUTRON DIFFRACTION NDE FOR ADVANCED COMPOSITES
D. S. Kupperman and S. Majumdar May 1988 6 p Presented at the ASME Winter Annual Meeting, Chicago, IL, 28 Nov. 1988 Submitted for publication
(Contracts W-31-109-eng-38; ANL-03355-730)
(DE88-012041; CONF-881120-3) Avail: NTIS HC A02

The strength and toughness of whisker- and fiber-reinforced composites are controlled to a large extent by the nature of bonding between the fibers/whiskers and the matrix. An important problem in the development of metal matrix and ceramic-ceramic matrix composites is the simultaneous measurement of whisker and matrix residual stress. In certain systems, chemical bonding is supposed to be nonexistent and frictional forces at the interfaces provide the necessary link between the fiber and the matrix. In metal matrix composites, stresses in the fibers can lead to thermal-cyclic fatigue damage. Strain measurements have been acquired nondestructively for alumina/silicon carbide and titanium/silicon carbide composites by means of neutron diffraction techniques at the Argonne National Laboratory Intense Pulsed Neutron Source. Analysis of the experimental results show that the in situ measurement of stress in the laboratory by neutron diffraction techniques is practical. The strain data accumulated could be used to calculate residual stresses in the fibers and the matrix (including stresses at the interface) simultaneously, or determine stresses resulting from external loading. DOE

N89-15180# Oak Ridge National Lab., TN.
TAILORING OF PROPERTIES OF SiC WHISKER-OXIDE MATRIX COMPOSITES
Terry N. Tiegs 1988 18 p Presented at the 3th International

Symposium on Ceramic Materials and Components for Engines, Las Vegas, NV, 27 Nov. 1988
(Contract DE-AC05-84OR-21400)
(DE88-016344; CONF-881125-1) Avail: NTIS HC A03/MF A01

Alumina and mullite reinforced with SiC whiskers have shown improved toughness and strength. The improvements are a result of crack-whisker interactions, such as crack bridging and deflection. The effectiveness of the interactions has been found to be functions of both the whisker physical characteristics and the surface chemistry. The important physical characteristics discussed are the diameter of the whiskers as well as the extraneous particulates associated with them. The whisker surface chemistry influences the bonding at the whisker-matrix interface. High toughness is observed when the bonding is limited and debonding can occur along the interface during crack propagation. DOE

N89-15181# Norton Co., Northboro, MA. Advanced Ceramics.
DEVELOPMENT OF TOUGHENED Si3N4 COMPOSITES BY GLASS ENCAPSULATED HOT ISOSTATIC PRESSURE Final Report
N. D. Corbin and C. A. Willkins Aug. 1988 60 p
(Contract DE-AC05-84OR-21400)
(DE89-001315; ORNL/Sub-86-95906/1) Avail: NTIS HC A04/MF A01

This one-year program was to develop fully dense Si3N4 matrix SiC whisker composites with enhanced properties over monolithic Si3N4 materials. Composites were prepared by a Reaction Bonded Silicon Nitride (RBSN) approach followed by Hot Isostatic Pressing (HIPing). The emphasis of this study was to determine the role of whisker aspect ratio, coatings on whiskers, nitridation environments and HIP parameters on composite properties. The ASEA HIP process which has the potential for producing near-net shaped complex geometries was used throughout this program. DOE

N89-15182*# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
ANALYSIS OF DELAMINATION RELATED FRACTURE PROCESSES IN COMPOSITES Final Report, 12 Feb. 1986 - 30 Sep. 1988
Erian A. Armanios 30 Sep. 1988 178 p
(Grant NAG1-637)
(NASA-CR-184603; NAS 1.26:184603) Avail: NTIS HC A09/MF A01 CSCL 11D

Delamination related fracture processes in composite materials are discussed. Thermal and moisture influences on the free-edge delamination of laminated composites, fracture analysis of local delaminations in laminated composites, and strain energy release rates in belts are among the topics covered. For individual titles, see N89-15183 through N89-15186.

N89-15183*# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
[INTRODUCTION TO THE ANALYSIS OF DELAMINATION RELATED FRACTURE PROCESSES IN COMPOSITES]
Erian A. Armanios and Lawrence W. Rehfield *In its* Analysis of Delamination Related Fracture Processes in Composites 30 Sep. 1988 22 p (For primary document see N89-15182 07-24)
Avail: NTIS HC A09/MF A01 CSCL 11D

This research concerns the analysis and prediction of delamination damage that occurs in composite structures on the sublaminate scale - that is, the scale of individual plies or groups of plies. The objective was to develop analytical models for fixed-mode delamination in composites. These include: (1) the influence of residual thermal and moisture strains; (2) local or transverse crack tip delamination originating at the tip of transverse matrix cracks; and (3) delamination in tapered composite under tensile loading. Computer codes based on the analytical models were developed and comparisons of predictions with available experimental and analytical results in the literature were performed. Author

N89-15184*# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
A STUDY ON THE THERMAL AND MOISTURE INFLUENCES ON THE FREE-EDGE DELAMINATION OF LAMINATED COMPOSITES M.S. Thesis
Mary A. Mahler *In its* Analysis of Delamination Related Fracture Processes in Composites 30 Sep. 1988 93 p (For primary document see N89-15182 07-24)
Avail: NTIS HC A09/MF A01 CSCL 11D

A simple delamination analysis method is presented here. It is based on a shear-type deformation theory and includes hygrothermal effects. These environmental conditions are applied to the strain energy release rate and interlaminar shear stresses. The method is applied to mixed mode edge delamination specimens made of T300/5208 graphite/epoxy material. Residual thermal and moisture stresses significantly influenced the strain energy release rate and interlaminar stresses. Both experienced large increases when thermal conditions were added to the mechanical strains. These effects were alleviated when moisture stresses were included. Thermal effects on the interlaminar shear stress and total energy release rate were totally alleviated for the same specific moisture content. Moreover, the value of the moisture content was not significantly affected by the stacking sequence for the laminates considered. Author

N89-15185*# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
FRACTURE ANALYSIS OF LOCAL DELAMINATIONS IN LAMINATED COMPOSITES
P. Sriram and Erian A. Armanios *In its* Analysis of Delamination Related Fracture Processes in Composites 30 Sep. 1988 41 p (For primary document see N89-15182 07-24)
Avail: NTIS HC A09/MF A01 CSCL 11D

A shear deformation model was developed to analyze local delaminations growing from transverse cracks in 90 degree plies located around the mid plane of symmetric laminates. The predictions of the model agree reasonably with experimental data from T300/934 graphite epoxy laminates. The predicted behavior is such that, in combination with an edge delamination model, the critical loads can be predicted accurately in the range of n from .5 to 8. Author

N89-15186*# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
[STRAIN ENERGY RELEASE RATE, INTERLAMINAR STRESSES, AND 3-D TRANSFORMATION OF STIFFNESSES]
In its Analysis of Delamination Related Fracture Processes in Composites 30 Sep. 1988 17 p (For primary document see N89-15182 07-24)
Avail: NTIS HC A09/MF A01 CSCL 11D

In this analysis, a delamination between the belt and core sections is assumed to grow parallel to the belt direction in the tapered and uniform sections. These delaminations in each section are denoted by a and b respectively. The core section in the taper portion is modeled by two equivalent sublaminates. The stiffness properties are smeared to obtain effective cracked and uncracked stiffnesses which are designated A (u) and A (c). These stiffnesses change from one ply drop group to another with crack growth a by experiencing a sudden change at discrete locations. Therefore, A (u) and A (c) can be represented in three consecutive regions. Author

N89-15187*# Boeing Commercial Airplane Co., Seattle, WA. Advanced Composite Development Program.
DAMAGE TOLERANT COMPOSITE WING PANELS FOR TRANSPORT AIRCRAFT
Peter J. Smith, Robert D. Wilson, and M. N. Gibbins Washington NASA Dec. 1985 60 p
(Contract NAS1-16863)
(NASA-CR-3951; NAS 1.26:3951) Avail: NTIS HC A04/MF A01 CSCL 11D

Commercial aircraft advanced composite wing surface panels were tested for durability and damage tolerance. The wing of a

fuel-efficient, 200-passenger airplane for 1990 delivery was sized using grahite-epoxy materials. The damage tolerance program was structured to allow a systematic progression from material evaluations to the optimized large panel verification tests. The program included coupon testing to evaluate toughened material systems, static and fatigue tests of compression coupons with varying amounts of impact damage, element tests of three-stiffener panels to evaluate upper wing panel design concepts, and the wing structure damage environment was studied. A series of technology demonstration tests of large compression panels is performed. A repair investigation is included in the final large panel test. B.G.

N89-15188# European Space Agency, Paris (France).
DAMAGE MECHANICS OF GRAPHITE/EPOXY LAMINATES DURING FATIGUE LOADING
Sep. 1988 288 p Transl. into ENGLISH from Schadensmechanik Kohlenstoffaserverstaerker Kunststoffe bei Schwingbelastung (Brunswick, Fed. Republic of Germany, DFVLR), 1988 250 p Original language document was announced as N88-18630 (ESA-TT-1093; DFVLR-Mitt-87-08; ETN-89-93633) Avail: NTIS HC A13/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 79 Deutsche marks

The influence of different parameters on the development of damage and on the properties of carbon fiber reinforced plastics (CFRP) was investigated. The initiation and propagation of damage in notched unidirectional and multidirectional carbon fiber reinforced epoxy resin laminates were investigated. Damage mechanisms in woven laminates under static and cyclic loading were studied. Measurement results concerning the safe life history of cyclic loaded carbon fiber reinforced composite materials were statistically analyzed. Damage mechanisms in CFRP riveted joints were investigated. The growth of delaminations in CFR laminated composites, and the final damage state were quantitatively described. For individual titles, see N89-15189 through N89-15195.

N89-15189# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Strukturmechanik.
CRP DAMAGE MECHANICS: A SURVEY
Rudolf Prinz *In* ESA, Damage Mechanics of Graphite/Epoxy Laminates during Fatigue Sep. 1988 p 8-30 Transl. into ENGLISH from Schadensmechanik Kohlenstoffaserverstaerker Kunststoffe bei Schwingbelastung (Brunswick, Fed. Republic of Germany, DFVLR), 1988 p 9-27 Original language document was announced as N88-18631 (For primary document see N89-15188 07-24)
Avail: NTIS HC A13/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 79 Deutsche marks

Failure mechanisms in composite laminates are discussed. Composite laminates can sustain many cracks before ultimate failure. Damage in composites can be breaks, resin cracks, interfacial debonds, and delaminations between the single laminate layers. The processes of damage in composite laminates under static and fatigue loading are described. The fracture process involves a sequential accumulation of damage, in the form of matrix-dominated transverse and longitudinal cracking and delamination. ESA

N89-15190# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Strukturmechanik.
INFLUENCE OF VARIOUS PARAMETERS ON DAMAGE PROPAGATION
Hans Christian Goetting *In* ESA, Damage Mechanics of Graphite/Epoxy Laminates during Fatigue Sep. 1988 p 31-69 Transl. into ENGLISH from Schadensmechanik Kohlenstoffaserverstaerker Kunststoffe bei Schwingbelastung (Brunswick, Fed. Republic of Germany, DFVLR), 1988 p 29-61 Original language document was announced as N88-18632 (For primary document see N89-15188 07-24)
Avail: NTIS HC A13/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 79 Deutsche marks

A test program was performed to investigate the influence of several parameters on damage development and the fatigue properties of carbon fiber reinforced plastics. The development of appropriate measuring techniques is discussed. The effects of the laminate stacking sequence, fatigue loading conditions, and environmental conditions like temperature and/or moisture were determined. The results provide a basis for a better understanding of the main damage mechanisms and their influence on fatigue life and reliability of carbon fiber reinforced plastics. ESA

N89-15191# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Strukturmechanik.
INVESTIGATIONS INTO INITIATION AND PROPAGATION OF DAMAGE IN NOTCHED UNI- AND MULTIDIRECTIONAL CRP LAMINATES
Ludwig Kirschke *In* ESA, Damage Mechanics of Graphite/Epoxy Laminates during Fatigue Sep. 1988 p 70-119 Transl. into ENGLISH from Schadensmechanik Kohlenstoffaserverstaerker Kunststoffe bei Schwingbelastung (Brunswick, Fed. Republic of Germany, DFVLR), 1988 p 63-104 Original language document was announced as N88-18633 (For primary document see N89-15188 07-24)
Avail: NTIS HC A13/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 79 Deutsche marks

Notched laminates made of carbon fiber reinforced epoxy resins were subjected to quasistatic stress tests and fatigue tests on unidirectional on-axis and off-axis specimens, and multidirectional specimens containing either two symmetric notches at the edges or a central hole. During loading of the specimens notch-opening displacements, crack lengths, local strains, and specimen elongations were measured. The state of damage of the specimens was analyzed by X-ray, ultrasonic C-scan, and raster electron microscopy. Based on the test results, parameters that characterize the state of damage were determined and a general understanding of crack initiation and damage development was obtained. The test data were used for a finite element calculation, leading to the evaluation of energy release rate and stress intensity factors. ESA

N89-15192# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Strukturmechanik.
DAMAGE TO ATLAS FABRIC LAMINATES UNDER STATIC AND FATIGUE LOADING
Klaus Schmidt *In* ESA, Damage Mechanics of Graphite/Epoxy Laminates during Fatigue Sep. 1988 p 120-152 Transl. into ENGLISH from Schadensmechanik Kohlenstoffaserverstaerker Kunststoffe bei Schwingbelastung (Brunswick, Fed. Republic of Germany, DFVLR), 1988 p 105-133 Original language document was announced as N88-18634 (For primary document see N89-15188 07-24)
Avail: NTIS HC A13/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 79 Deutsche marks

The mechanical properties and the damage mechanisms of a laminate with four layers and an asymmetric stacking sequence were investigated. The laminate was made of eight-end sateen weave prepregs. Static tests, tension-tension, and tension-compression fatigue tests were performed. The in-plane shear properties were determined by loading the material in a rail shear apparatus. The damage initiation and growth up to failure were observed by an optical microscope and other nondestructive test methods such as X-ray radiography and ultrasonic-C-scans. The value of the stress or the number of cycles for which the first transverse cracks or the first buckling of fibers were obtained was recorded. ESA

N89-15193# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Strukturmechanik.

STATISTICAL ASSESSMENT OF DATA FROM FATIGUE STRENGTH INVESTIGATIONS ON CRP COMPOSITE STRUCTURES

Lutz vonBonin *In* ESA, Damage Mechanics of Graphite/Epoxy Laminates during Fatigue Sep. 1988 p 153-214 Transl. into ENGLISH from Schadensmechanik Kohlenstoffaserverstaerker Kunststoffe bei Schwingbelastung (Brunswick, Fed. Republic of Germany, DFVLR), 1988 p 135-188 Original language document was announced as N88-18635 (For primary document see N89-15188 07-24)

Avail: NTIS HC A13/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 79 Deutsche marks

Measurement results concerning the safe life history of cyclic loaded CFRP-composite materials were statistically analyzed. The results yield the statistical frequency distribution, and a resultant failure rate comparison with appropriate types of distribution shows whether the number of cycles to failure correlates well with fracture probability. The confidence in statements concerning rate of failure, based on the frequency distribution of measured data, depends strongly on sample number and variance of the distribution. Even small variances, together with small sample numbers, deform the confidence limits so strongly that the resulting predictions on the failure characteristics become useless. However, there is no use in expanding the sample number beyond certain limits, if the variance cannot be reduced simultaneously. Calculations show that 10 to 12 samples per test series is sufficient if a constant variance is assured. ESA

N89-15194# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Strukturmechanik.

DAMAGE MECHANISMS OF CRP RIVET JOINTS

Dirk Wetzel *In* ESA, Damage Mechanics of Graphite/Epoxy Laminates during Fatigue Sep. 1988 p 215-241 Transl. into ENGLISH from Schadensmechanik Kohlenstoffaserverstaerker Kunststoffe bei Schwingbelastung (Brunswick, Fed. Republic of Germany, DFVLR), 1988 p 189-209 Original language document was announced as N88-18636 (For primary document see N89-15188 07-24)

Avail: NTIS HC A13/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 79 Deutsche marks

The behavior of carbon epoxy composite materials joined by rivets was studied in order to evaluate the design parameters under different climatic conditions. Static and quasistatic loading tests were performed at room temperature and at 70C, and a relative humidity of 40 percent. The effects of fiber material, fabric, and laminate were determined for different rivet diameters, layer geometry, fiber orientation, and laminate thickness. It is shown that a riveted joint loses part of its strength due to local deformation of the rivet. ESA

N89-15195# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Strukturmechanik.

DAMAGE MECHANISMS AND LIFE ASSESSMENT OF CRP LAMINATES

Rudolf Prinz *In* ESA, Damage Mechanics of Graphite/Epoxy Laminates during Fatigue Sep. 1988 p 242-287 Transl. into ENGLISH from Schadensmechanik Kohlenstoffaserverstaerker Kunststoffe bei Schwingbelastung (Brunswick, Fed. Republic of Germany, DFVLR), 1988 p 211-246 Original language document was announced as N88-18637 (For primary document see N89-15188 07-24)

Avail: NTIS HC A13/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 79 Deutsche marks

The growth of delaminations in unnotched and notched carbon fiber reinforced laminated composites, and the final damage state are quantitatively described. Fatigue tests were performed, and an analytical model for the development of delaminations which permits the estimation of the number of loading cycles up to buckling was developed. Delaminations between composite layers can result from interlaminar stresses developing at the stress-free edges et discontinuities like holes, cut fibers, matrix cracks, or impact damage. Under cyclic loading, delaminations can grow up to the final damage state, where the delaminated sublaminate starts to buckle. ESA

N89-15196# Royal Air Force Coll., Cranwell (England). Dept. of Transport Technology.

SECONDARY CONSIDERATIONS FOR THE USE OF CARBON FIBRE REINFORCED PLASTICS IN MISSILES M.S. Thesis

R. J. Appleyard 1988 106 p Prepared in cooperation with Loughborough Univ. of Technology (England)

(ETN-89-93568) Avail: NTIS HC A06/MF A01

The properties of CFRP are analyzed showing how they are related to missile structural requirements. Manufacturing methods are examined since they are closely linked with design from the early stages through to the finished product and into service. Design principles and specifications are discussed, including comments on filament winding, molding, and injection molding manufacturing techniques. ESA

N89-15197# Centre d'Essais Aeronautique Toulouse (France).

CERTIFICATION TESTS OF PREIMPREGNATED CARBON-EPOXY X636/R6376 FROM CIBA GEIGY. TEST REPORT M6-570400 Final Report [ESSAIS DE QUALIFICATION DU PREIMPREGNE CARBONE/EPOXY X636/R6376 DE CIBA-GEIGY. PROCES-VERBAL M6-570400]

M. Loriot 24 Nov. 1987 73 p In FRENCH

(Contract STPA-83-96-003)

(Rept-M6-570400; ETN-89-93609) Avail: NTIS HC A04/MF A01

Physical tests on nonpolymerized material and mechanical tests on stratified polymerized specimens were carried out. The physical methods employed included infrared spectrophotometry, liquid chromatography, differential microcalorimetry, and thermogravimetric analysis. The quantitative results of chemical composition are given. The tensile results indicate the presence of a second generation carbon fiber. The compression tests on 80 ply specimen show a reduction of 15 percent of the resistance values after wet aging and fatigue. ESA

N89-15198# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.

FATIGUE DAMAGE IN COMPOSITES UNDER DIFFERENT LOADING CONDITIONS

W. G. J. tHart 25 Feb. 1988 42 p

(Contract NIVR-1744)

(NLR-TR-88032-U; ETN-89-93893) Avail: NTIS HC A03/MF A01

The damage development in notched (+ or - 45, O2, 90, O2)s carbon-epoxy coupon specimens tested under different loading conditions was determined. Constant amplitude tests at R = 1 and R = 0.1 as well as flight simulation tests were performed to establish stress values for which no damage growth occurs. Constant amplitude testing reveals fatigue limits for no damage growth at 1 million cycles, of 133 MPa and 267 MPa, respectively. Literature data for equivalently notched 2024-T3 are 90 MPa and 135 MPa for similar stress ratios. Flight simulation tests using MINI-TWIST and a block program approximating the cumulative frequency distribution of MINI-TWIST results in a mean stress level of 133 MPa at which no damage growth occurs. At this stress level the fatigue life of equivalently notched 2024-T3 is 5000 flights. Constant amplitude testing at R = -1 shows the most reproduceable fatigue damage development. Therefore testing at R = -1 seems to be the most appropriate for selecting materials on the basis of resistance to delamination damage growth. ESA

N89-15199 Utah Univ., Salt Lake City.
INVESTIGATION OF IMPACT IN ADVANCED COMPOSITES Ph.D. Thesis
Andreas Panayiotou Christoforou 1988 122 p
Avail: Univ. Microfilms Order No. DA8816629

A combined experimental analytical study was conducted to explore the mechanics of lateral impact in fiber composites. Pressure tests were carried out on composite cylinders that had been previously subjected to low velocity impact by a heavy mass. The test results show a definite reduction in burst strength for all the internal support conditions used in the impact experiments. Two simple models are presented, which when compared with the experimental data, demonstrate that the basic features of the impact event are represented. A failure model based on linear laminated shell theory and linear fracture mechanics seems to represent the general trends of the data. A nonlinear ring model gives good insight into the physics of the impact event in the presence of delaminations and the resulting nonlinear effects. A method is presented for the analysis of simply supported orthotropic cylindrical shells subjected to impact loading. The solution has not been obtained previously. The analysis shows that the response frequency, or the contact duration is independent of the impact velocity, and depends on the mass ratio and the material and geometrical parameters of the shell. Dissert. Abstr.

N89-15200*# Wyoming Univ., Laramie. Composite Materials Research Group.
MECHANICAL PROPERTIES OF NEAT POLYMER MATRIX MATERIALS AND THEIR UNIDIRECTIONAL CARBON FIBER-REINFORCED COMPOSITES Interim Report, May 1984 - May 1985
Richard S. Zimmerman and Donald F. Adams Dec. 1988 209 p
(Grant NAG1-277)
(NASA-CR-181631; NAS 1.26:181631; UWME-DR-601-103-1)
Avail: NTIS HC A10/MF A01 CSCL 11D

The mechanical properties of two neat resin systems for use in carbon fiber epoxy composites were characterized. This included tensile and shear stiffness and strengths, coefficients of thermal and moisture expansion, and fracture toughness. Tests were conducted on specimens in the dry and moisture-saturated states, at temperatures of 23, 82 and 121 C. The neat resins tested were American Cyanamid 1806 and Union Carbide ERX-4901B(MPDA). Results were compared to previously tested neat resins. Four unidirectional carbon fiber reinforced composites were mechanically characterized. Axial and transverse tension and in-plane shear strengths and stiffness were measured, as well as transverse coefficients of thermal and moisture expansion. Tests were conducted on dry specimens only at 23 and 100 C. The materials tested were AS4/3502, AS6/5245-C, T300/BP907, and C6000/1806 unidirectional composites. Scanning electron microscopic examination of fracture surfaces was performed to permit the correlation of observed failure modes with the environmental test conditions. Author

N89-15201*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THE ROLE OF RAPID SOLIDIFICATION PROCESSING IN THE FABRICATION OF FIBER REINFORCED METAL MATRIX COMPOSITES
Ivan E. Locci (Case Western Reserve Univ., Cleveland, OH.) and Ronald D. Noebe Jan. 1989 45 p
(NASA-TM-101450; E-4449; NAS 1.15:101450) Avail: NTIS HC A03/MF A01 CSCL 11D

Advanced composite processing techniques for fiber reinforced metal matrix composites require the flexibility to meet several widespread objectives. The development of uniquely desired matrix microstructures and uniformly arrayed fiber spacing with sufficient bonding between fiber and matrix to transmit load between them without degradation to the fiber or matrix are the minimum requirements necessary of any fabrication process. For most applications these criteria can be met by fabricating composite monotapes which are then consolidated into composite panels or more complicated components such as fiber reinforced turbine blades. Regardless of the end component, composite monotapes are the building blocks from which near net shape composite structures can be formed. The most common methods for forming composite monotapes are the powder cloth, foil/fiber, plasma spray, and arc spray processes. These practices, however, employ rapid solidification techniques in processing of the composite matrix phase. Consequently, rapid solidification processes play a vital and yet generally overlooked role in composite fabrication. The future potential of rapid solidification processing is discussed.
Author

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*.

N89-15202 Purdue Univ., West Lafayette, IN.
IN SITU BURNING-RATE DETERMINATION USING FLASH RADIOGRAPHY Ph.D. Thesis
Homer Mars Pressley, Jr. 1987 379 p
Avail: Univ. Microfilms Order No. DA8807659

A hybrid method for non-intrusive, in situ burning rate measurements in solid propellant rocket motors that combines the temporal continuity of the indirect method (employment of measured pressure and thrust data to predict detailed internal phenomena through a model of the internal processes) and the direct, time mean but spatially resolved measurements of the radiographic approach was developed and employed. Results indicate that the technique can determine propellant burning-rates within approximately 3.0 percent. Dissert. Abstr.

N89-15203 Michigan Univ., Ann Arbor.
TURBULENT COMBUSTION IN A JET STIRRED REACTOR Ph.D. Thesis
Chang-Sheng Tai 1987 123 p
Avail: Univ. Microfilms Order No. DA8801427

The applicability of a jet stirred reactor for the study of constant volume turbulent flame propagation was confirmed by generating combustion data for methane/air mixtures that agree with that reported in the literature which employed a fan stirred reactor. The turbulent burning veloicities were measured for Mira-Gel, cornstarch, polyethylene, para-dichlorobenzene, graphite, corncobs, oil treated sweepings, and Pittsburgh seam coal. The turbulence level inside the reactor was measured using a Laser Doppler Anemometer (LDA), and the results deviate slightly from the previously measured hot-wire results. The values of the laminar burning velocity for coal dust obtained by this method are of the same magnitude as those obtained from open flame tubes. Since all parameters are controllable with this apparatus, the combustion phenomena of cornstarch or graphite dust mixed with methane/air mixtures was also investigated. The relationship between the ratio of turbulent to laminar burning velocity and turbulence level for methane/air flame is obtained from the experiment and this matches with an other three-region model of a turbulent flame. This research was conducted in order to obtain fundamental data under tightly controlled conditions and to attempt to understand the basic mechanisms of heterogeneous combustion in order to prevent dust and hybrid explosions in industrial situations.
Dissert. Abstr.

N89-15204 New South Wales Univ., Kensington (Australia).
THE EFFECT OF SURFACE PRETREATMENT ON THE PERFORMANCE OF ULTRAFILTRATION MEMBRANES Ph.D. Thesis
Kyu-Jin Kim 1987 4 p
Avail: Issuing Activity

The fouling of ultrafiltration (UF) membranes by protein was reduced by surface pretreatment with various surfactants and

polymers. Methods of treatment included passive adsorption, convection and the formation of Langmuir-Blodgett (LB) monolayers. In most cases the pretreatment provided an increase in initial UF flux and a slower flux decline. Average flux advantages of membranes treated with non-ionic surfactants (nonyl phenol polyethoxylates) over untreated membranes were about 20 percent and the maximum advantage was about 50 percent for first usage. Flux improvement for polymer treated membranes was similar to that for surfactant treated membranes. Membranes pretreated by formation of LB monolayers also showed similar trends of increased initial UF flux and reduced flux decline. Surface pretreatment of UF membranes by surfactants and polymers can reduce the fouling in protein UF. The pretreatment is beneficial because it renders the surface more permeable (decreases local polarization at pores) and reduces surface rugosity. Changes in hydrophilicity also have a detectable, but possibly minor role. Author

N89-15205# State Univ. of New York, Binghamton. Dept. of Chemistry.
PHOTOCHEMICAL OBSERVATION OF ION FLOWS IN MEMBRANE CHANNELS Annual Report, 1 Jun. 1987 - 31 May 1988
Michael E. Starzak 1 Jul. 1988 6 p
(Contract N00014-87-K-0301; RR04108)
(AD-A198252) Avail: NTIS HC A02/MF A01 CSCL 07D

Two new experimental techniques focus on the kinetics and mechanism of ion permeation through channels in bilayer membranes. Laser Doppler velocimetry, optimized for the study of ion flows in membrane channels, generates the velocity distribution for these ions. This velocity distribution provides detailed kinetic information on the mechanism of ion permeation. Modulation of the absorption and fluorescence spectra of Ti(I) ions in membrane channels using a pulse sequence or sinusoidal transmembrane potential permits the detection of small changes in intrachannel Ti(I) as a function of membrane potential. The technique is used to determine the fraction of total current which is carried by Ti(I) ion when the bathing solution contains mixtures of K(I) and Ti(I) ions. These data are used to elucidate the mechanisms of permeation and channel blockage by these ions. GRA

N89-15206# Arizona Univ., Tucson.
A REVOLUTION IN OPTICAL SPECTROSCOPY HIGH PERFORMANCE ARRAY DETECTORS Technical Report, 15 May 1988 - 30 Apr. 1989
M. B. Denton 4 Feb. 1988 4 p
(Contract N00014-86-K-0316)
(AD-A198591; TR-55) Avail: NTIS HC A02/MF A01 CSCL 14B

Recent investigations will be presented which demonstrate how new types of charge transfer device (CTD) array detectors can provide vastly superior performance to conventional approaches in a variety of optical spectroscopic applications. Operational characteristics of the two major classes of CTD's - charge coupled devices (CCD) and charge injection devices (CID) - will be briefly reviewed. Examples demonstrating the trade offs between the two classes of CTD's and their relative merits will be presented. Entirely new spectroscopic frontiers such as the Intelligent Atomic Emission Spectrometer will be discussed. The ability to employ the vast amount of data available real time from a properly configured array detector can offer major advances in precision and accuracy. The concepts behind this approach, along with the advantages, will be presented. GRA

N89-15207# Maryland Univ., College Park. Dept. of Physics and Astronomy.
SCANNING TUNNELING MICROSCOPY AS A SURFACE CHEMICAL PROBE Final Report, 1 Dec. 1984 - 31 May 1988
Ellen D. Williams 31 May 1988 20 p
(Grant AF-AFOSR-0042-85; AF Proj. 2303)
(AD-A199922; AFOSR-88-0968TR) Avail: NTIS HC A02/MF A01 CSCL 07B

The instrumentation needed for combining a new imaging technique, Scanning Tunneling Microscopy (STM), with standard surface analytical methods has been developed. The surface analytical capabilities of a new system were demonstrated by a study of the barium catalyzed oxidation of nickel. The operation of the STM has been demonstrated by a detailed study of the imaging of the graphite surface. The changes in graphite imaging with tunneling voltage have been measured and compared with theoretical predictions of the effect of surface change density and surface deformation on imaging via STM. The combination of STM with the surface analytical probes has been demonstrated in a comparison of LEED and STM measurements of a stepped Si surface. It is shown that LEED is rather insensitive to structural changes that are readily apparent using STM. GRA

N89-15208# General Electric Co., Schenectady, NY.
CARBON MONOXIDE AND TURBULENCE-CHEMISTRY INTERACTIONS: BLOWOFF AND EXTINCTION OF TURBULENT JET DIFFUSION FLAMES Final Report, 1 May 1985 - 1 Jun. 1988
S. M. Correa 31 Aug. 1988 78 p
(Contract F49620-85-C-0035)
(AD-A199961; Rept-88SRD012; AFOSR-88-0935TR) Avail: NTIS HC A05/MF A01 CSCL 21B

Turbulence chemistry interactions have been studied experimentally and theoretically in the context of turbulent diffusion flames. The goal is a quantitative understanding of these interactions under a wide range of conditions. These range from low Reynolds number conditions (weak interactions, affecting primarily the levels of intermediate species, pollutants and combustion efficiency) to high Reynolds number conditions, where the flame can be extinguished by intense turbulent straining. Jet flames in coflowing air have been emphasized, with a coannular pilot burner used where necessary for stabilization at the burner lip. Fuels have consisted of carbon dioxide/H2 mixtures with the fraction of hydrogen successively reduced to promote extinction. Reynolds numbers have been increased to the point of blowoff. Major species and temperature have been measured by Raman scattering, and velocity and turbulence have been measured by laser velocimetry. These experiments have provided a comprehensive set of data on CO/H2 flames, extending to conditions conducive to localized extinction. The data show significant temperature decrements due to finite-rate chemistry but no evidence of localized extinction. GRA

N89-15209# Case Western Reserve Univ., Cleveland, OH. Center for Electrochemical Sciences.
OXYGEN REDUCTION ON ADSORBED IRON TETRAPYRIDINO PORPHYRAZINE Technical Report, 1987 - 1988
A. A. Tanaka, C. Fierro, D. A. Scherson, and E. Yeager 1 Sep. 1988 46 p Submitted for publication
(Contract N00014-83-K-0343)
(AD-A200024; TR-66) Avail: NTIS HC A03/MF A01 CSCL 07C

The electrocatalytic properties of iron tetrapyridino porphyrazine FeTPyPz for the reduction of O2 in alkaline media have been examined with cyclic voltammetry and rotating ring disk techniques. Four distinct redox peaks are observed in the absence of O2 in solution for this material adsorbed at monolayer coverages on ordinary pyrolytic graphite surfaces. The onset for O2 reduction appears to coincide with the voltammetric peak associated with the metal centered Fe(II) TPyPz/Fe(III)TPyPz transition. No hydrogen peroxide is detected at the ring in this potential range indicating that the reaction takes place by a four electron pathway. This is in contrast with the behavior observed. This change in the mechanism has been attributed to the further reduction of the ion center in the macrocycle rendering an Fe(I)TPyPz species. If the electrode is polarized at potentials more negative than -0.8 V vs SCE, however, the reduction proceeds once again without generation of H2O2 in the solution phase. GRA

N89-15210# Air Force Astronautics Lab., Edwards AFB, CA.
SOLID PROPELLANT FLAME SPECTROSCOPY Interim Report, Jan. 1984 - Jan. 1988

J. T. Edwards Aug. 1988 229 p
(AD-A199334; AFAL-TR-88-076) Avail: NTIS HC A11/MF A01 CSCL 21I

This report summarizes the progress made in solid propellant flame chemistry studies. These chemistry studies involved the spectroscopic determination of species concentration and temperature profiles in solid propellant flames at pressures from atmospheric to 7 MPa (1000 psi). The propellants involved contained AP and HMX, as well as several other formulations. The molecules studied were OH, CH, NH, and NO, primarily, although other atomic and molecular species were seen in the propellant flames in emission. The primary diagnostic employed was laser-induced fluorescence (LIF), although the chemiluminescence (emission) from the propellant flames was also studied. These experiments are continuing. GRA

N89-15211# Ballistic Research Labs., Aberdeen Proving Ground, MD.
FACILITY FOR VISUALIZATION OF LIQUID PROPELLANT SPRAY COMBUSTION AT HIGH PRESSURES
Avi Birk and Phil Reeves Jul. 1988 25 p
(AD-A199370; BRL-MR-3684) Avail: NTIS HC A03/MF A01 CSCL 21I

An injector-combustor assembly and a dedicated flow system, currently under construction, are described which allow the photography and spectroscopy of liquid propellant spray combustion in high pressure and temperature clear inert gas environments. The gas is pressure regulated from a room temperature reservoir and is heated convectively in a particle bed heater prior to entering a windowed chamber (combustor). The unique particle bed has a heat capacity of 0.67 cal/cm C and up to 2 KW/cm power density for gas heating. Typically, steady state gas flow pressure and temperature are obtained in the combustor after 1 sec for a duration of 4 sec with downward velocities of less than 1 m/sec and temperatures ranging from 400 C to 800 C for pressures of 10 MPa to 69 MPa. GRA

N89-15212# Naval Research Lab., Washington, DC. Synchrotron Radiation Research Group.
APPLICATIONS OF LAYERED SYNTHETIC MICROSTRUCTURES IN VACUUM ULTRAVIOLET AND SOFT X-RAY GRATING SPECTROMETERS Interim Report, Mar. - Jul. 1988
J. C. Rife 14 Sep. 1988 55 p
(AD-A199539; NRL-MR-6278) Avail: NTIS HC A04/MF A01 CSCL 20F

Potential multilayer grating applications for the wavelength region from 6 to 350 A are discussed. Multilayer bandwidth and efficiency as affected by stack construction as well as the effects of roughness and corrections to Bragg's law are considered. Grating performance is reviewed with attention to the limitations to high resolving powers and spectral purity in fabrication and instrument design. Combined multilayer grating performance is discussed for both broad and narrow band coatings. Designs for 10 to 40 A 1,000,000 resolution, broad-band spectrograph/monochromator are explored. GRA

N89-15213# Lawrence Livermore National Lab., CA.
FABRICATION OF HOLLOW SILICA AEROGEL MICROSPHERES USING DROPLET GENERATION TECHNIQUE AND SOL-GEL PROCESS
N. K. Kim, K. Kim, D. A. Payne (Illinois Univ., Urbana.), and R. S. Upadhye 3 Oct. 1988 18 p Presented at the 35th National Vacuum Symposium and 4th International Laser Science Conference, Atlanta, GA, 2 Oct. 1988
(Contract W-7405-eng-48)
(DE89-000673; UCRL-21120; CONF-881002-10) Avail: NTIS HC A03/MF A01

A system was designed to produce hollow silica aerogel microspheres by combining a droplet generation technique and a sol-gel process. In the system, a simultaneous passage of an alkoxide solution and a fill gas through a dual-nozzle system found a continuous stream of hollow drops in the fluid state. The spherical drops were then levitated in a basic atmosphere to convert them into a rigid state by an accelerated reaction of condensation. A supercritical drying was adopted to drive off any remaining organic solvent in order to form porous aerogel spheres. DOE

N89-15214# Ford Motor Co., Dearborn, MI. Engine Research Dept.
RESEARCH PROGRAM ON REDUCED COMBUSTION CHAMBER HEAT LOSS EFFECTS ON ALTERNATIVE FUEL COMBUSTION
E. E. Daby, I. J. Garwin, P. H. Havstad, and C. E. Hunter Oct. 1988 149 p Prepared in cooperation with ORNL
(Contract DE-AC05-84OR-21400)
(DE89-001316; ORNL/Sub-87-95918/1) Avail: NTIS HC A07

A research program was conducted to determine the effects of thermal barriers in the combustion chamber of a diesel engine on the combustion and emissions of selected alternative fuels. Comparison of steady state fuel economy, exhaust emissions, and combustion data of heat insulated, baseline water-cooled, and high compression ratio engines were made using three fuels. Fuels believed to be representative of the year 2000 fuel were selected for the study. In fact, the light cycle oil fuel used was similar to CAPE.32 fuel (No. 6). Ceramic coatings and solid ceramic inserts were used to insulate the combustion chamber of the heat insulated, uncooled engine. Fuel economy and NOx emissions were generally lower for the heat insulated, uncooled engine than for the baseline engine and high compression water-cooled engine. Light load hydrocarbons were lower for the high compression ratio engine than for those of the baseline engine; however, hydrocarbon emissions for the heat insulated engine were higher than those of the baseline engine over the complete range of engine operating conditions tested. Heat insulating the combustion chamber and operating the water-cooled engine at elevated intake air temperature and high compression ratio reduced ignition delay and premixed combustion while increasing the amount of diffusion combustion. Further optimization of the combustion chamber, air motion, and the injection system of the heat insulated, uncooled engine may result in additional reductions in exhaust emissions not observed during this study. DOE

N89-15215# National Bureau of Standards, Gaithersburg, MD.
SOFT X-RAY ABSORPTION AND EMISSION SPECTRA AND THE ELECTRONIC STRUCTURE OF SOME EXOTIC MATERIALS
D. L. Ederer, L. R. Canfield, T. A. Callcott, K. L. Tsang, C. H. Zhang, and E. T. Arakawa (Oak Ridge National Lab., TN.) 1988 6 p Presented at the X-ray and Vacuum Ultraviolet Interaction Data Bases, Calculations, and Measurements, Los Angeles, CA, 14 Jan. 1988
(Contract DE-AC05-84OR-21400)
(DE89-001207; CONF-8801115-1) Avail: NTIS HC A02/MF A01

The technique of soft X-ray fluorescence spectroscopy (SXE) is complimentary to that of photoemission spectroscopy (PES). SXE probes the local partial density of states (PDOS), selects dipole allowed symmetries, and is not necessarily surface sensitive. PES on the other hand, averages over the DOS and can be used to measure the dispersion of the energy bands. PES is also very surface sensitive. We present measurements on the high T sub c superconductors, the quasicrystalline phase of AlMn, and the LiAl intermetallic alloy. These measurements provide insight for theoretical modeling. In the case of the high T sub c compound and the intermetallic compound the measurements are in good agreement with the theory. However, for the quasicrystals the measurements provide new insights to challenge theory. DOE

N89-15216 Prins Maurits Lab. TNO, Rijswijk (Netherlands).
CALCULATION OF BREAKTHROUGH CURVES FOR ACTIVATED CARBON FILTERS. PART 4: CONTINUOUS VERSUS PULSATING AIR FLOW IN THE ABSORPTION OF CARBON TETRACHLORIDE BY ACTIVATED CARBON IN A RESPIRATOR CARTRIDGE [BEREKENING VAN DOORBRAACKCURVEN VAN ACTIEVE-KOOLFILTERS. DEEL 4: CONTINUE VERSUS PULSERENDE LUCHTSTROOM BIJ DE ADSORPTIE VAN TETRA AAN ACTIEVE KOOL IN EEN GASMASKERFILTERBUS]
J. J. G. M. vanBokhoven Sep. 1987 26 p In DUTCH; ENGLISH summary
(PML-1987-29-Pt-4; TD-88-0924-Pt-4; ETN-89-93452) Copyright Avail: Prins Maurits Lab., Inst. for Chemistry in Technological Research, P.O. Box 45, 2280 AA Rijswijk, Netherlands

The breakthrough curves of activated carbon filters were investigated in order to determine the maximum service life of respirator cartridges. Experiments and computer simulations were performed to examine the differences between breakthrough curves obtained with continuous and pulsating flow through the canister of air containing a certain concentration of the organic vapor to be adsorbed. The differences are found to be significant. Calculations show that in case of low bed lengths or more severe breakthrough criteria the deviation in breakthrough times becomes so large that the continuous experiment is fully unrealistic for practical service life tests. It is in principle possible to simulate the practical situation of discontinuous flow experimentally using continuous flow. ESA

N89-15217# Ballistic Research Labs., Aberdeen Proving Ground, MD.
THERMAL DECOMPOSITION OF RDX AND RDX-BOROHYDRIDE MIXTURES
Michael A. Schroeder Sep. 1988 49 p
(AD-A199371; BRL-MR-3699) Avail: NTIS HC A03/MF A01 CSCL 19A

GCMS studies on the thermal decomposition of RDX, both alone and in mixtures with K2B12H12 are reported. A number of these less volatile products are formed. 1,3,5-triazine has been conclusively identified for the first time as a decomposition product of RDX. This is mechanistically significant because it suggests the operation of either some form of N-NO2 cleavage or of intermolecular CH abstraction. Crude estimates of the effects on 1,3,5-triazine formation of temperature and of added K2B12H12 have been made and are briefly discussed. Other products are still under study: those identified to date include mononitroso-RDX (MRDX) and unreacted RDX. Author

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N89-15218*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
HIGH RESOLUTION VIDEO MONITORING OF COATING THICKNESS DURING PLASMA SPRAYING
Robert A. Miller 1988 6 p Presented at the National Thermal Spray Conference, Cincinnati, OH, 23-27 Oct. 1988; sponsored in part by ASM
(NASA-TM-101423; E-4523; NAS 1.15:101423) Avail: NTIS HC A02/MF A01 CSCL 11F

A new approach to monitoring the thickness of plasma sprayed coatings during application is described. The method employs a high resolution video camera and width analyzer to accurately measure the dimensions of samples having simple geometries. This approach is best suited for cylindrical or flat substrates but it may also work for selected locations on more complex geometries. Measurement accuracy is a function of specimen dimensions and extent of magnification. Tolerances of plus or minus 0.5 mil (0.13 mm) on final coating thickness can be achieved. Additionally, the plot of cumulative coating thickess versus the number of passes has proven to be a useful diagnostic tool. While the ideal plot is linear, strong deviations from linearity - indicating the need for corrective action - may be observed. Author

N89-15219# Army Construction Engineering Research Lab., Champaign, IL.
CORROSION MITIGATION AND MATERIALS SELECTION GUIDE FOR MILITARY CONSTRUCTION IN A SEVERELY CORROSIVE ENVIRONMENT Final Report
Vincent F. Hock, Richard G. Lampo, Susan A. Johnston, and James R. Myers Jul. 1988 150 p
(AD-A199921; CERL-TR-M-88/03) Avail: NTIS HC A07/MF A01 CSCL 13B

The U.S. Army Corps of Engineers guidance for military construction in the Middle East, called Standard Overseas Guide Specifications (SOGS), are reviewed to insure they incorporate the most effective corrosion mitigation techniques. The Middle East environment presents a unique set of corrosivity problems due to the desert sand, high winds, and warm, salt-laden atmosphere. These conditions, along with operation and maintenance constraints, can lead to costly premature corrosion failures. Recommendations are given for optimizing protection against corrosion in this environment. This guidance can be incorporated into the SOGS where information is incomplete, outdated, or lacking; it can also be considered for revising the applicable Corps of Engineers Guide Specifications (CEGS). GRA

N89-15220# Rockwell International Science Center, Thousand Oaks, CA.
PROCESSABILITY AND HIGH TEMPERATURE BEHAVIOR OF EMERGING AEROSPACE ALLOYS Annual Report No. 2, 1 May 1987 - 30 Apr. 1988
A. K. Ghosh and C. G. Rhodes Aug. 1988 41 p
(Contract F49620-86-C-0058)
(AD-A199926; SC5459.AR; AFOSR-88-0970TR) Avail: NTIS HC A03/MF A01 CSCL 11F

Part 1 of this program examines a unified approach for understanding and assessing microstructure changes under the influence of different modes of thermomechanical and deformation processing. Experimental validation of the microstructure changes occurring in advanced aluminum alloys, such as SiC particulate reinforced aluminum, high strength P/M aluminum and high temperature aluminum alloy, Al-8Fe-4Ce, are being conducted. Progress of microstructural refinement and changes in misorientation between subgrains are determined to delineate the path for optimum processability for these alloys. The effects of various processing conditions on texture and elevated temperature deformation characteristics have been studied. Part 2 of the program is a study of the effects of Fe, C, O, and Si as minor additions and Nb and V as major additions of Ti-22Al-8Nb on 675 C creep behavior. The results have demonstrated that the effects of the individual additives on creep resistance for the Ti3Al base alloy are essentially the same as those previously observed for conventional titanium alloys. Si and Si + Zr are effective for improving creep resistance of the alpha-two alloys by pinning mobile dislocations during creep exposure. GRA

N89-15221# United Technologies Research Center, East Hartford, CT.
DISPERSION STRENGTHENING OF HIGH TEMPERATURE NIOBIUM ALLOYS Annual Report, May 1987 - May 1988
D. L. Anton, D. B. Snow, and A. F. Giamei 31 May 1988 46 p
(Contract F49620-86-C-0053)
(AD-A199958; UTRC/R88-917437-2; AFOSR-88-0979TR) Avail: NTIS HC A03/MF A01 CSCL 11F

Niobium base alloys are very attractive as high temperature materials for advanced gas turbine applications. After many conventional metallurgical approaches, a high temperature creep resistant alloy has yet to be identified which will replace nickel base superalloys. The best chance for obtaining high temperature creep resistance in these alloys is through dispersion strengthening with a stable precipitate that is introduced through rapid solidification. This would result in a very fine dispersion of

nonshearable precipitates that would not coarsen upon long term exposure at temperatures in excess of 1200 C. A study has been conducted here to identify such a stable dispersion, fabricate alloys through a rapid solidification approach and characterize the coarsening of the resulting precipitates. A thermodynamic argument is presented to select candidate dispersions for evaluation. GRA

N89-15222# Northwestern Univ., Evanston, IL. Dept. of Materials Science and Engineering.
SEPARATION OF THE MACRO- AND MICRO-STRESSES IN PLASTICALLY DEFORMED 1080 STEEL
R. A. Winholtz and J. B. Cohen Aug. 1988 16 p
(Contract N00014-80-C-0116)
(AD-A199337; TR-26) Avail: NTIS HC A03/MF A01 CSCL 11F

The stress tensors were measured with X-ray diffraction in both the ferrite and cementite phases of a 1080 steel specimen deformed in uniaxial tension. The macro- and micro-stresses were separated for all the components of the stress tensors. All the components except the hydrostatic components of the micro-stresses could be determined without an accurate value of the unstressed lattice parameter. Tensile stresses were found in the cementite and compressive stresses in the ferrite along the deformation direction. The tensile stresses in the cementite were quite large. GRA

N89-15223# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Materials Engineering.
FRACTURE MECHANISMS IN IRON AND NICKEL ALUMINIDES Final Report, 1 Mar. 1984 - 31 May 1988
N. S. Stoloff 15 Aug. 1988 48 p
(Contract N00014-84-K-0276)
(AD-A199365) Avail: NTIS HC A03/MF A01 CSCL 11F

The high cycle fatigue (HCF) resistance of several boron-doped Nickel Aluminide alloys has been determined over a range of test temperatures. Fatigue and tensile properties of two Ni-rich ternary alloys were much superior to those of the cast 26 percent Al alloy or a P/M alloy with 9.3 percent Manganese. Crack paths were transgranular in the Ni-rich alloys and intergranular or interdendritic in Ni-26 percent Al. HCF lives decreased sharply at temperatures above 500C. Crack growth rates increased with temperatures to 600C, in spite of a rising yield stress over the same temperature range, perhaps due to oxygen-induced embrittlement. Single crystals of Ni3Al+B displayed a marked flow stress assymetry in tension and compression. Point defects were observed in large numbers; these condense into voids, thereby contributing to each crack initiation. The high cycle fatigue (HCF) and crack growth resistance of several Iron Aluminide-type alloys was determined in the temperature range 25 to 600C. Long range order (DO3 type) was effective in prolonging high cycle fatigue lives in Fe-28.1 percent Al, but not in FE-23.7 percent Al at 25C. Crack growth rates were higher in the DO3 condition. Fatigue results on both Ni3Al and Fe3Al alloys are discussed on the basis of microstructure, surface slip band development and internal dislocation substructures revealed by transmission electron microscopy. GRA

N89-15224# Dayton Univ., OH.
CAST ALUMINUM BONDING STUDY Interim Technical Report, Dec. 1986 - Dec. 1987
Ronald J. Kuhbander, Steven J. Caldwell, and Scott E. Fiscus May 1988 30 p
(Contract F33615-86-C-5031)
(AD-A199533; UDR-TR-87-137; AFWAL-TR-88-4065) Avail: NTIS HC A03/MF A01 CSCL 11F

High quality aluminum alloy castings are finding application on Air Force weapon systems due to the significant cost savings over those components machined from plate stock. However, it is unknown if durable adhesively bonded joints can be fabricated using present bonding technology with castings. The cast aluminum alloy used was A357. The surface preparation was phosphoric acid anodize (PAA) which has proven to be an excellent prep for aluminum plate stock, in particular if durability was considered. Specimens were prepared with two aircraft type epoxy adhesives, and the effects of temperature, environmental exposure, and long-term durability were measured and are presented. It appears that high quality adhesively bonded joints can be achieved using cast aluminum adherends and current aluminum surface preparation technology. GRA

N89-15225# Lawrence Livermore National Lab., CA.
AN ANALYSIS OF MATERIALS SELECTED FOR MOCKING HIGH-STRAIN-RATE MECHANICAL BEHAVIOR OF URANIUM ALLOYS
R. S. Rosen, J. J. Oldani, and M. E. Kassner 15 Sep. 1988 13 p
(Contract W-7405-eng-48)
(DE89-000489; UCRL-53884) Avail: NTIS HC A03/MF A01

We studied the mechanical behavior of U-6Nb and compared it with the behavior of AISI 1215 and AISI 1045 steels. We performed conventional tensile tests at varying strain rates and Hopkinson split-bar dynamic compressive tests to determine flow stress as a function of strain rate. We also performed Charpy V-notch impact tests to measure absorbed fracture energy. We used regression analysis to calculate a constitutive equation, flow stress evaluated at constant plastic strain, and D and p are strain-rate sensitivity constants for each of the three materials. This equation relates flow stress to strain rate up to very high strain rates. Our extrapolation for uranium and the constitutive equation for AISI 1045 both agree closely with data from the literature. Our findings indicate that AISI 1045 and U-6Nb exhibit comparable stress-strain and fracture behavior but that AISI 1215 fractures at lower stress levels and absorbs much less energy during fracture than does U-6Nb. We also evaluated the mechanical behavior of tantalum, which has Hugoniot properties comparable to those of uranium, and found that the strain-rate sensitivity, fracture energy, and ductility are all much more pronounced for tantalum than for uranium. DOE

N89-15226# Pacific Northwest Labs., Richland, WA.
STATISTICAL EVALUATION OF UNOBSERVED NONUNIFORM CORROSION IN A216 STEEL
B. A. Pulsipher Jul. 1988 21 p
(Contract DE-AC06-76RL-01830)
(DE89-001010; PNL/SRP-6637) Avail: NTIS HC A03/MF A01

Tests designed to promote nonuniform corrosion have been conducted at PNL on A216 steel. In all of the tests performed to date, there have been no manifestations of significant nonuniform corrosion. Although this may suggest that nonuniform corrosion in A216 steel may not be a significant problem in the nuclear waste repository, a question arises as to whether enough tests have been conducted for a sufficient length of time to rule out nonuniform corrosion of A216 steel. In this report, a method for determining the required number of tests is examined for two of the mechanisms of nonuniform corrosion: pitting and crevice corrosion. DOE

N89-15227# Colorado Univ., Boulder.
CHEMISTRY OF BIMETALLIC AND ALLOY SURFACES Progress Report, 1 Feb. 1986 - 31 Jan. 1989
Bruce Koel Oct. 1988 12 p
(Contract DE-FG02-86ER-13473)
(DE89-002066; DOE/ER-13473/3) Avail: NTIS HC A03/MF A01

We have investigated the following major areas important to understanding bimetallic and alloy surface chemistry and catalysis: (1) the influence of potassium on the interactions of ethylene and other hydrocarbon species with platinum, (2) the determination of ensemble size requirements for adsorption and reaction on platinum surfaces, (3) the influence of oxygen adatoms on the bonding of nitric oxide to platinum, and (4) the role of the electronic structure of the metal surface in controlling surface chemistry. All of these studies were carried out using surface science techniques on well-characterized metal surfaces. The specific systems studied were chosen to discriminate among and elucidate the various factors responsible for the altered properties and chemistry of bimetallic surfaces. DOE

N89-15228# Oak Ridge National Lab., TN. Metals and Ceramics Div.
HELIUM EFFECTS ON NEUTRON-IRRADIATED Cr-Mo FERRITIC STEELS: A REVIEW OF RECENT RESULTS
R. L. Klueh and P. J. Maziasz 1988 41 p Presented at the 14th International Symposium on Effects of Radiation on Materials, Andover, MA, 27 Jun. 1988
(Contract DE-AC05-84OR-21400)
(DE89-001197; CONF-880613-22) Avail: NTIS HC A03/MF A01

Large amounts of transmutation helium will be produced in the first wall of a fusion reactor by the high-energy neutrons from the fusion reaction. Since no fusion reactor is available, the effect of simultaneous helium production and displacement damage from neutron irradiation must be simulated. One method that has been used in ferritic steels is to add nickel to the steels and irradiate them in a mixed-spectrum reactor. In such reactors, the fast neutrons produce displacement damage, while helium is produced by a two-step reaction of Ni-58 with thermal neutrons. This technique has been used to investigate the effect of helium on swelling, tensile properties, impact properties, and elevated-temperature embrittlement. Results indicate that helium accelerates swelling and affects tensile and impact properties of Cr-Mo ferritic steels below approx. 450 C. However, these steels are highly resistant to elevated-temperature helium embrittlement. DOE

N89-15229# Brookhaven National Lab., Upton, NY.
OUTGASSING AND DESORPTION OF THE STAINLESS STEEL BEAM TUBES AFTER DIFFERENT DEGASSING TREATMENTS
H. C. Hseuh and Xiuhua Cui 1988 19 p Presented at the 35th National Vacuum Symposium and 4th International Laser Science Conference, Atlanta, GA, 2 Oct. 1988
(Contract DE-AC02-76CH-00016)
(DE89-001268; BNL-41181; CONF-881002-14) Avail: NTIS HC A03/MF A01

Chemical cleaning, vacuum firing, glow discharge cleaning and insitu bakeout have become standard practice for lowering the outgassing rate and removing surface contaminants in the ultra high vacuum systems of particle accelerators and storage rings. This paper presents the work done with the thermal outgassing of several long stainless steel (304LN and 316L) beam chambers with areas of more than 1 x 10000 sq cm. They were measured between 20 C and 500 C after vacuum firing, glow discharge cleaning or reactive gas (nitric oxide) cleaning. Outgassing rates of low 10 to the -13 and low 10 to the -14 Torr .1/s. sq cm were achieved for H2 and CO, respectively, with vacuum firing alone. The outgassing of H2 in this temperature range is consistent with that due to bulk diffusion with an enthalpy of 9 + or - 1 Kcal/mole. The photon stimulated desorption of the chamber surface after the above treatments were also studied by exposure to an intense photon beam at the National Synchrotron Light Source. The effectiveness and merits of reactive gas cleaning in removing the surface contaminants in large vacuum systems are compared to those of vacuum firing and glow discharge cleaning. DOE

N89-15230# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
CORROSION FATIGUE CRACK ARREST IN ALUMINUM ALLOYS: BASIC DATA
R. J. H. Wanhill and L. Schra 7 Jul. 1987 120 p
(Contract NIVR-01102-N)
(NLR-TR-87128-U; ETN-89-93888) Avail: NTIS HC A06/MF A01

Constant amplitude low stress intensity fatigue crack growth for 2024-T3 and 7475-T761 aluminum alloys in laboratory air, sump tank water, and synthetic seawater was investigated. Corrosion fatigue crack growth retardation and arrest occur in sump tank water and synthetic seawater, resulting in higher Delta Kth values than in air. Crack arrest is due to crack blocking by corrosion product layers. Enhancing crack arrest, and hence the durability of aircraft structures, appears to be feasible. ESA

N89-15231# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
LONG-TERM OUTDOOR STRESS CORROSION TESTING OF OVERAGED 7000 SERIES ALUMINUM ALLOYS
L. Schra and W. G. J. tHart 31 Jan. 1988 45 p
(Contracts NIVR-1743; NIVR-1906)
(NLR-TR-88012-U; ETN-89-93891) Avail: NTIS HC A03/MF A01

Outdoor stress corrosion cracking (SCC) tests were executed on overaged 7000 series aluminum alloy plate and forgings. Plate material of the alloys 7010-T7651, 7010-T7451, and 7075-T7351 exhibits excellent resistance to SCC. Powder metallurgy alloy X7091-T7E69 forgings combine a higher strength with superior SCC resistance as compared to ingot alloy forgings. The SCC resistance of forgings of the alloys 7075-T73 and 7050-T74 is substantially better than that of forgings of the alloys 7175-T74, 7010-T74 and AZ74.61. When strength is taken into account only the SCC propagation resistance of 7010-T74 is clearly inferior to that of the other alloys. Accelerated laboratory tests do not always enable a correct prediction of the SCC resistance. The SCC growth is affected by corrosion product wedging which may also occur in aircraft structures and complicates prediction of SCC growth. ESA

N89-15232*# Virginia Univ., Charlottesville. Dept. of Materials Science.
ENVIRONMENT ASSISTED DEGRADATION MECHANISMS IN ADVANCED LIGHT METALS Progress Report, 1 Jun. - 31 Dec. 1988
R. P. Gangloff, G. E. Stoner, and R. E. Swanson Jan. 1989 169 p
(Grant NAG1-7452)
(NASA-CR-181049; NAS 1.26:181049; UVA/528266/MS89/103)
Avail: NTIS HC A08/MF A01 CSCL 11F

A multifaceted research program on the performance of advanced light metallic alloys in aggressive aerospace environments, and associated environmental failure mechanisms was initiated. The general goal is to characterize alloy behavior quantitatively and to develop predictive mechanisms for environmental failure modes. Successes in this regard will provide the basis for metallurgical optimization of alloy performance, for chemical control of aggressive environments, and for engineering life prediction with damage tolerance and long term reliability. B.G.

N89-15233*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THE OXIDATION OF Ni-RICH Ni-Al INTERMETALLICS
Joseph Doychak (Sverdrup Technology, Inc., Cleveland, OH.), James L. Smialek, and Charles A. Barrett Sep. 1988 17 p Presented at the Workshop on the Oxidation of High-Temperature Intermetallics, Cleveland, OH, 22-23 Sep. 1988; sponsored in part by NASA, ASMI, Case Western Reserve Univ., AIME and TMS-AIME
(NASA-TM-101455; E-4438; NAS 1.15:101455) Avail: NTIS HC A03/MF A01 CSCL 11F

The oxidation of Ni-Al intermetallic alloys in the beta-NiAl phase field and in the two phase beta-NiAl/gamma'-Ni3Al phase field has been studied between 1000 and 1400 C. The stoichiometric beta-NiAl alloy doped with Zr was superior to other alloy compositions under cyclic and isothermal oxidation. The isothermal growth rates did not increase monotonically as the alloy Al content was decreased. The characteristically ridged alpha-Al2O3 scale morphology, consisting of cells of thin, textured oxide with thick growth ridges at cell boundaries, forms on oxidized beta-NiAl alloys. The correlation of scale features with isothermal growth rates indicates a predominant grain boundary diffusion growth mechanism. The 1200 C cyclic oxidation resistance decreases near the lower end of the beta-NiAl phase field. Author

N89-15267# Ecole Nationale Superieure des Mines, Valbonne (France). Centre dEtude de Mise en Forme des Materiaux.
A COMPUTER PROGRAM SIMULATING THE HOT FORGING OF METAL POWDER
E. Wey, C. Levaillant, and J. L. Chenot *In* AGARD, Aerospace Materials Process Modelling Aug. 1988 10 p (For primary document see N89-15262 07-31)
Copyright Avail: NTIS HC A12/MF A01

N89-15268# Middle East Technical Univ., Ankara (Turkey). Dept. of Metallurgical Engineering.
MICROSTRUCTURES, FLOW PROPERTIES AND PROCESSING OF TI6242 ALLOY
Alpay Ankara and Taylan Altan (Ohio State Univ., Columbus.) *In* AGARD, Aerospace Materials Process Modelling Aug. 1988 13 p (For primary document see N89-15262 07-31)
Copyright Avail: NTIS HC A12/MF A01

N89-15270# Ecole Nationale Superieure des Mines, Valbonne (France).
SUPERPLASTIC BEHAVIOUR OF SOME TI-6AI-4V ALLOYS INVESTIGATED BY TORSION TESTING
Y. Combres, C. Levaillant, and F. Montheillet (Ecole Nationale Superieure des Mines, Sainte-Etienne, France) *In* AGARD, Aerospace Materials Process Modelling Aug. 1988 13 p (For primary document see N89-15262 07-31)
Copyright Avail: NTIS HC A12/MF A01

N89-15271# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Gennevilliers (France).
THE FORGE 2 ISOTHERMAL FORGING MODEL [LE MODELE DE FORGEAGE ISOTHERME FORGE 2]
P. E. Mosser and Y. Germain *In* AGARD, Aerospace Materials Process Modelling Aug. 1988 11 p In FRENCH; ENGLISH summary (For primary document see N89-15262 07-31)
Copyright Avail: NTIS HC A12/MF A01

N89-15272# Liege Univ. (Belgium).
COMPUTER PREDICTION OF INTERNAL STRESSES DURING HEAT TREATMENT
D. Assaker and M. Hogge *In* AGARD, Aerospace Materials Process Modelling Aug. 1988 15 p (For primary document see N89-15262 07-31)
Copyright Avail: NTIS HC A12/MF A01

N89-15281# Cameron Force Co., Houston, TX.
THE APPLICATION OF PROCESS MODELLING TO HEAT TREATMENT OF SUPERALLOYS
R. A. Wallis, N. M. Bhathena, P. R. Bhowal, and E. L. Raymond *In* AGARD, Aerospace Materials Process Modelling Aug. 1988 15 p (For primary document see N89-15262 07-31)
Copyright Avail: NTIS HC A12/MF A01

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials*.

N89-15234# Sandia National Labs., Albuquerque, NM.
LOW-DENSITY MICROCELLULAR CARBONIZED POLYACRYLONITRILE (PAN) FOAMS
A. P. Sylwester 1988 5 p Presented at the JOWOG-28 Meeting, Albuquerque, NM, 1 Oct. 1988
(Contract DE-AC04-76DP-00789)
(DE88-016526; SAND-88-2376C; CONF-8810151-3) Avail: NTIS HC A02/MF A01

Carbon foams are of interest for numerous applications including: porous electrodes, filters, high temperature insulation, catalyst supports, and as structural materials for the fabrication of inertial confinement fusion targets. Carbon foams have improved thermal and chemical stability when compared to polymer foams and provide improved dimensional stability. We have reported a new process for preparing carbon foams which involves the preparation of low-density PAN foams which can be carbonized. The unique properties of these materials and several developing applications for carbonized PAN foams are described. DOE

N89-15235*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ADDITION POLYMERS FROM 1,4,5,8-TETRAHYDRO-1,4;5,8-DIEPOXYANTHRACENE AND BIS-DIENES. 2: EVIDENCE FOR THERMAL DEHYDRATION OCCURRING IN THE CURE PROCESS
Mary Ann B. Meador, Michael A. Olshavsky, Michael A. Meador, and Myong-Ku Ahn (Indiana State Univ., Terre Haute.) [1988] 8 p Proposed for presentation at the 197th National Meeting of the American Chemical Society, Dallas, TX, 9-14 Apr. 1989
(NASA-TM-101385; E-4442; NAS 1.15:101385) Avail: NTIS HC A02/MF A01 CSCL 11C

Diels-Alders cycloaddition copolymers from 1,4,5,8-tetrahydro-1,4;5,8-diepoxyanthracene and anthracene end-capped polyimide oligomers appear, by thermogravimetic analysis (TGA), to undergo dehydration at elevated temperatures. This would produce thermally stable pentiptycene units along the polymer backbone, and render the polymers incapable of unzipping through a retro-Diels-Alder pathway. High resolution solid 13C nuclear magnetic resonance (NMR) of one formulation of the polymer system before and after heating at elevated temperatures, shows this to indeed be the case. NMR spectra of solid samples of the polymer before and after heating correlated well with those of the parent pentiptycene model compound before and after acid-catalyzed dehydration. Isothermal gravimetric analyses and viscosities of the polymer before and after heat treatment support dehydration as a mechanism for the cure reaction. Author

N89-15236# Stanford Univ., CA. Dept. of Chemical Engineering.
OBSERVATION AND MANIPULATION OF POLYMERS BY SCANNING TUNNELING AND ATOMIC FORCE MICROSCOPY
M. M. Dovek, T. R. Albrecht, S. W. Kuan, C. A. Lang, and R. Emch 13 Jul. 1988 21 p
(Contract N00014-87-K-0426)
(AD-A198255; TR-11) Avail: NTIS HC A03/MF A01 CSCL 07D

The properties of monolayer films of organic materials are important for a variety of technologies. We have employed the STM and AFM to study Langmuir-Blodgett films of a variety of polymers on substrates of graphite, molybdenum sulfate, and gold (111) on mica. The polymers were poly(octadecyl acrylate) (PODA), atactic and syndiotactic poly(methyl methacrylate) (PMMA) and poly(2-methyl 1-pentene sulfone) (PMPS). One striking feature was the degree of order observed; a second was the morphological difference between films of submonolayer thickness (long thin fibrils) and those of at least monolayer thickness (lumpy structures arranged in domains). By pulsing the STM bias voltage to values in excess of 4 V, we were able to bring about local modification of the polymer morphology. GRA

N89-15237# Florida Univ., Gainesville. Dept. of Materials Science and Engineering.
ULTRASTRUCTURE PROCESSING AND ENVIRONMENTAL STABILITY OF ADVANCED STRUCTURAL AND ELECTRONIC MATERIALS Final Report, 1 Apr. 1985 - 31 Mar. 1988
Larry L. Hench 1 Sep. 1988 38 p
(Contract F49620-85-C-0079)
(AD-A199905; AFOSR-88-0972TR) Avail: NTIS HC A03/MF A01 CSCL 11B

The objective of our Multi-Investigator Research Program is to achieve an understanding of the science of chemically derived, ultrastructure processing of ceramics, glasses and composites. Five research areas were pursued. Sol-Gel Processing: Procedures for reliable and reproducible drying of sol-gel silica monoliths were developed using drying control chemical additives (DCCA's). Processes for chemical stabilization of ultraporous, optically

transparent silica monoliths were also developed along with the means for chemically doping of optically active polymers. A method for dehydration and densification of the ultrapure silica monoliths was also achieved resulting in optical components with uniquely low optical transmission from 160 nm to 3500 nm. The gel-derived optical silica also has a uniquely low coefficient of thermal expansion over a broad temperature range. GRA

N89-15238# Babcock and Wilcox Co., Lynchburg, VA.
A NEW PROCESS FOR FINAL DENSIFICATION OF CERAMICS Final Report, 15 Feb. 1985 - 14 May 1988
R. A. Wagner 14 May 1988 67 p
(Contract F49620-85-C-0053; ARPA Order 5172; AF Proj. 2303)
(AD-A199959; AFOSR-88-1008TR) Avail: NTIS HC A04/MF A01 CSCL 11B

The objective of this program was to demonstrate the feasibility of novel densification process based on supercritical fluids. Using this process carbon/carbon composites were impregnated with silicon carbide precursors and pyrolyzed to produce oxidation resistant pore coatings. The resulting samples were characterized in terms of silicon distribution, mechanical properties, and oxidation resistance. The solubility behavior of candidate carbon and silicon carbide precursors was determined in supercritical propane and carbon dioxide. In addition, two silicon carbide precursors were fractionated and characterized to establish the molecular weight dependence of the char yield. The results of the solubility and fractionation studies were then used to guide the impregnation program. GRA

N89-15239# Texas Univ., Arlington. Dept. of Chemistry.
SOLUBLE ETHYLMERCAPTO SUBSTITUTED POLYTHIOPHENES
Jose P. Ruiz, K. Nayak, Dennis S. Marynick, and John R. Reynolds 27 Sep. 1988 41 p
(Contract N00014-86-K-0769)
(AD-A199960; TR-10) Avail: NTIS HC A03/MF A01 CSCL 07F

Polymers of 3-ethylmercapto and 3,4-bis(ethylmercapto)thiophenes have been synthesized and characterized. These polymers are soluble in common organic solvents such as methylene chloride, chloroform and THF. Structural characterization using FT-IR and NMR spectroscopy show that these polymers have a well-defined beta-ethylmercapto substituted 2,5-(thienylene) polymeric structure. Visible-near IR absorption spectra of electrochemically doped cast films and chemically doped solutions of the polymers show that they can be oxidized to form bipolaronic species. GPC studies show a number average molecular weight of about 2500 (M w/M n approx. 5) for both polymers. Maximum electrical conductivities of 10-3/ohm/cm for the 3-ethylmercapto, and 10 to the -7th for the 3,4-bis(ethylmercapto) substituted polymers have been obtained in the oxidized state. Experimental results are correlated with theoretical calculations using the PRDDO and extended Huckel methods, which demonstrate radical-cation reactivities for the thiophene monomers, along with minimum energy conformations and band structures in these substituted polymers. GRA

N89-15240# Connecticut Univ., Storrs. Liquid Crystalline Polymer Research Center.
X-RAY DIFFRACTION BY THERMOTROPIC MAIN-CHAIN POLYMERS HAVING SIDE GROUPS. PART B: RIGID POLYESTERS
Hui H. Chin, Leonid V. Azaroff, Agya R. Saini, and Robert W. Lenz 7 Sep. 1988 16 p Prepared in cooperation with Massachusetts Univ., Amherst
(Contract N00014-86-K-0772)
(AD-A199302; TR-18) Avail: NTIS HC A03/MF A01 CSCL 07F

Thermotropic poly(sulfonyl hydroquinone terephthalate) with either H or CH3 in the lateral substituent, was aligned by drawing from nematic melts. Virtually identical X-ray intensity distributions were recorded consisting of disks of intensity periodically spaced along the meridian and concentric rings of intensity lying in the equatorial plane of reciprocal space. They correspond to what is expected for the hexagonal packing of parallel periodic chains that are randomly displaced along the chain axes. Using interactive graphics, appropriate molecular models were deduced in conformity with the observed diffraction intensities. GRA

N89-15241# Rennes Univ. (France).
NEW FLUORIDE GLASSES FOR THE PREPARATION OF INFRARED OPTICAL FIBERS Periodic Report No. 4, Sep. 1987 - Mar. 1988
J. Lucas Mar. 1988 6 p
(Contract DAJA45-86-C-0050)
(AD-A199400) Avail: NTIS HC A02/MF A01 CSCL 20F

New zirconium-free fluoride glasses are investigated for I.R. optical fibers operating up to 5 to 5.5 microns. A five-component glass having the composition in molar percent fluoride Ba30In30Zn20Y10Th10 has been optimized for rods and preforms preparation. F/Cl substitution as well as Na addition allow small variations in the refractive index. Two attempts on rods fibering were positive and demonstrated the possibility of obtaining BIZYT optical fibers without significant crystallization. Purification of indium and Yb based materials has been undertaken. GRA

N89-15242# Hunter Coll., New York. Dept. of Physics and Astronomy.
NMR (NUCLEAR MAGNETIC RESONANCE) STUDIES OF Na(+)-ANION ASSOCIATION EFFECTS IN POLYMER ELECTROLYTES Interim Report
S. G. Greenbaum, Y. S. Pak, M. C. Wintersgill, and J. J. Fontanella 23 Aug. 1988 21 p
(Contract N00014-85-K-0304)
(AD-A199455; TR-13) Avail: NTIS HC A03/MF A01 CSCL 07C

Na-23 nuclear magnetic resonance (NMR) measurements on poly(propylene oxide) (PPO) and siloxane based polymer electrolytes containing various sodium salts at a single nominal concentration are reported. In addition, differential scanning calorimetry (DSC) and electrical conductivity studies were carried out on the PPO materials. The NMR-determined mobile Na(+) concentrations and DSC results provide evidence for ionic aggregation effects which, for some samples, result in salt precipitation at elevated temperatures. Na-23 chemical shifts observed in solid state NMR due to mobile Na(+) ions are obtainable without the use of high resolution techniques, and exhibit strong dependences on anion and temperature. These results indicate the Na(+)-anion interactions influence ionic transport as well as the number of available carriers. GRA

N89-15243# Naval Surface Warfare Center, Silver Spring, MD. Research and Technology Dept.
SYNTHESIS OF ENERGETIC MATERIALS Annual Progress Report, 1 Jan. - 31 Dec. 1987
M. Chaykovsky and W. M. Koppes Mar. 1988 19 p
(AD-A199472) Avail: NTIS HC A03/MF A01 CSCL 07C

Salts of ethylenedinitramine (EDNA) and methylenedinitramine (MEDINA) reacted successfully with 4, 5-dichloro-1, 3-dioxalan-2-one to yield bicyclic carbonate esters, which underwent ester cleavage with boron tribromide to give 2, 3-dibromo-1, 4-dinitropyrazine and 4, 5-dibromo-1, 3-dinitroimidazolidine respectively. Attempts to convert the latter dibromide into bicyclo-HMX by reaction with salts of MEDINA were unsuccessful, probably as a result of debromination leading to an unstable olefinic cyclic dinitramine. (U) The cyclic dinitramine derivative, 2, 3-diacetoxy-1, 4-dinitropyrazine reacted with excess ethyl urethane, under boron trifluoride catalysis in trifluoroacetic acid, to give the 2, 3-bisurethane derivative. This conversion represents the first successful attempt to introduce nitrogen functionality adjacent to a nitramino group to form an animal-type linkage. Similarly, the diacetoxy pyrazine reacted with urea to give a bicyclic urea derivative, which was nitrated with nitric acid-acetic anhydride to yield the tetranitro-tetraazabicyclononanone. GRA

N89-15244# California Univ., Berkeley. Lawrence Berkeley Lab.
THE PRODUCTION AND CHARACTERIZATION OF MID-GAP STATES IN TRANS-POLYACETYLENE Ph.D. Thesis
C. F. Hoener Aug. 1988 142 p
(Contract DE-AC03-76SF-00098)
(DE89-000273; LBL-25889) Avail: NTIS HC A07/MF A01

Photoinduced IR absorptions with much longer lifetimes and lower excitation energies than previously reported were observed after the photolysis of polyacetylene with upsilon greater than 5000 cm (-1). These absorptions are similar to those previously reported to have millisecond lifetimes, and are attributed to charged bond-alternation defects. The persistent photoinduced absorptions could be depleted by photoexcitation of a transition with an absorption maximum near 4000 cm (-1). Unpaired spins were observed to develop and be depleted at the same photolysis frequencies as the IR activity. These spins may be due to the charged defects. This would mean that the defects are charged polarons. The temperature required to dope polyacetylene chemically was measured for various dopants. This was taken to be a measure of the activation energy for the doping reaction. The activation energies were found to be much lower than predicted by stepwise reaction mechanisms. Photolysis with above-band-gap light did not alter the temperature required for reaction. The chemical stabilization of photoinduced defects does not occur at a perceptible rate at lower temperatures than the chemical doping reaction. DOE

N89-15245# Ceramatec, Inc., Salt Lake City, UT.
PROCESSING AND CHARACTERIZATION OF TRANSFORMATION-TOUGHENED CERAMICS WITH STRENGTH RETENTION TO ELEVATED TEMPERATURES: FINAL REPORT
R. A. Cutler, J. J. Hansen, D. W. Prouse, J. D. Bright, A. V. Virkar, and D. K. Shetty Jul. 1988 69 p Prepared in cooperation with ORNL
(Contract DE-AC05-84OR-21400)
(DE89-001312; ORNL/Sub-85-22028/1) Avail: NTIS HC A05/MF A01

Al2O3-ZrO2 three layered composites were fabricated in such a way that the outer layers of the bar-shaped specimens consisted of Al2O3 and unstabilized ZrO2, and the inner layer consisted of Al2O3 and partially-stabilized ZrO2. Upon cooling from the sintering temperature, part of the ZrO2 in the outer layers transformed from tetragonal (t) to monoclinic (m), while the inside layer ZrO2 remained tetragonal. The transformation created compressive stresses in the outer layers and tensile stresses in the bulk. The depth of the outer layers (and therefore the magnitude of the residual stresses) was controlled during green forming. Residual stresses at room temperature varied depending on the outer layer thickness. The increased strengths of the three layer specimens were obtained in the as-fired unground condition, demonstrating that the stresses introduced are the result of transformation-induced stresses during cooling, and did not from transformation produced by grinding. Specimens with residual surface compressive stresses were 200 MPa stronger at 750 C than monolithic specimens, demonstrating the viability of this approach for improving elevated temperature mechanical properties. Strain gauge, X-ray diffraction, and indentation/strength measurements were used to verify the existence of the macroscopic residual stresses. Slip casting and tape casting were investigated as alternative green forming routes to powder pressing. The substitution of HfO2 for ZrO2 in order to increase the transformation temperature was investigated. DOE

N89-15246# Lawrence Livermore National Lab., CA.
MICROSTRUCTURAL CHARACTERIZATION OF LOW-DENSITY FOAMS
C. W. Price 1988 19 p Presented at the Fine Particle Society Meeting, Santa Clara, CA, 19 Jul. 1988
(Contract W-7405-eng-48)
(DE88-016171; UCRL-98594; CONF-8807110-1) Avail: NTIS HC A03/MF A01

Low-density foams (of the order 0.1 g per cubic cm) synthesized from silica aerogel, resorcinol/formaldehyde, and cellulose acetate have fine, delicate microstructures that are extremely difficult to characterize. Improved low-voltage resolution of an SEM equipped with a field-emission gun (FESEM) does permit these materials to be examined directly without coating and at sufficient magnification to reveal the microstructures. Light coatings applied by ion-beam deposition can stabilize the specimens to some extent and reduce electron charging without seriously altering the microstructure, but coatings applied by conventional techniques usually obliterate these microstructures. Transmission electron microscopy (TEM) is required to provide unambiguous microstructural interpretations. However, TEM examinations of these materials can be severely restricted by specimen preparation difficulties and electron-beam damage, and considerable care must be taken to ensure that reasonably accurate TEM results have been obtained. This work demonstrates that low-voltage FESEM analyses can be used to characterize microstructures in these foams, but TEM analyses are required to confirm the FESEM analyses and perform quantitative measurements. DOE

N89-15247# California Univ., Berkeley. Lawrence Berkeley Lab. National Center for Electron Microscopy.
STRUCTURE AND BONDING OF DIAMOND AND DIAMOND-LIKE MATERIALS: MICROANALYTICAL CHARACTERIZATION AT HIGH SPATIAL RESOLUTION
K. M. Krishnan, D. F. Blake, F. Freund, and R. J. Lipari Mar. 1988 13 p Presented at the Spring Meeting of the Materials Research Society, Reno, NV, 4 Apr. 1988
(Contract DE-AC03-76SF-00098)
(DE89-001254; LBL-25268; CONF-880408-38) Avail: NTIS HC A03/MF A01

We summarize the results of our studies of explosively compacted diamond particles, microwave plasma enhanced CVD diamond films and diamond-like residues of extraterrestrial carbon (C-delta residue) by microdiffraction, energy dispersive X-ray spectroscopy and electron energy-loss spectroscopy, all using nanometer-scale electron probes and by electron spectroscopy for chemical analysis, a complementary bulk spectroscopic method. However, the characterization of the C-delta residue is particularly emphasized. DOE

N89-15248# Norton Co., Northboro, MA.
PROCESSING OF SINTERABLE TRANSFORMATION TOUGHENED CERAMICS FOR APPLICATION IN CERAMIC TECHNOLOGY FOR ADVANCED HEAT ENGINES PROJECT Final Report
G. A. Rossi, J. B. Blum, C. E. Knapp, and K. E. Manwiller Sep. 1988 75 p Prepared for Oak Ridge National Lab., TN
(Contract DE-AC05-84OR-21400)
(DE89-001313; ORNL/Sub-85-22031/1) Avail: NTIS HC A05/MF A01

Three main types of zirconia toughened ceramics (ZTC) were investigated as potential candidates for heat engine applications, i.e., Mg-PSZ (MgO-Partially Stabilized Zirconia), Y-TZP (Y2O3-Tetragonal Zirconia Polycrystals), and ZTA (Zirconia Toughened Alumina). The powders were prepared either via chemical routes or by melting, rapid solidification, and wet milling. Hot isostatic pressing was used in the exploratory part of this program in order to quickly evaluate the potential of each composition without the necessity of optimizing the powder processing composition (Y-TZP) considerable effort was devoted to minimize foreign contaminants and processing flaws in order to improve the properties and the reliability of the ceramics. The Mg-PSZ ceramics could not be fabricated due to persistent cracking problems. The Y-TZP ceramics made with the rapidly solidified (R/S) powders have met all objectives, except the strength and toughness at 1000 C. We believe that the strength goal of 500 MPa at 1000 C for pressureless sintered Y-TZP ceramics is attainable through improvements in processing, but the K sub IC goal of 6 MPa.m sup 1/2 at 1000 C is unrealistic, in view of the lack of transformation toughening at high temperature. The ZTA ceramics have exhibited much better strength and toughness retention at high temperature, vis a vis the Y-TZP materials. These

ceramics seem to possess the highest potential for meeting the program goals, but much more processing efforts are needed to optimize their microstructure and maximize their properties. Other advantages of the ZTA materials vs. the Y-TZPs are their lower cost and potentially better resistance to low temperature degradation in the 200 to 300 C range. DOE

N89-15249# Sandia National Labs., Albuquerque, NM.
SUMMARY OF AGING EFFECTS ON 25-YEAR OLD NYLON PARACHUTES
E. L. Tadios 1988 10 p Presented at the 10th AIAA Aerodynamic Decelerator Systems Technology Conference, Cocoa Beach, FL, 18 Apr. 1988
(Contract DE-AC04-76DP-00789)
(DE89-001378; SAND-88-2494C; CONF-8804204-1) Avail: NTIS HC A02/MF A01

Structural evaluations were conducted on several parachute systems to determine the effects of aging on parachute materials. Most of the parachutes were 25 years old. Five 64 ft parachutes were evaluated along with one 4 ft guide surface parachute and three 16.5 ft ribbon parachutes. The parachute systems used in the study were all fabricated from nylon materials. Results were obtained for several material properties such as tensile strength, air permeability and melting point. Military specifications were used as zero-time data base due to lack of raw material data. The results indicate that over a period of about 25 years, parachute nylon materials do not degrade to unacceptable levels. DOE

N89-15250# Brookhaven National Lab., Upton, NY. Dept. of Applied Sciences.
A NEW IONIC CONDUCTING POLYMER BASED ON OLIGO(ETHYLENE OXIDE) SUBSTITUTED NYLON-1
H. Liu, H. S. Lee, Y. Okamoto, L. F. Liu, and T. Skotheim 1987 16 p Presented at the Symposium on Electroresponsive Polymers, Upton, NY, 4 Oct. 1987 Prepared in cooperation with Polytechnic Univ., Brooklyn, NY
(Contract DE-AC02-76CH-00016)
(DE89-001098; BNL-41199; CONF-8710283-6) Avail: NTIS HC A03/MF A01

Complexes of the polymer CF3SO3Li were prepared and the ionic conductivities as a function of ethylene oxide unit length were measured. In this paper, we report the preliminary results with these systems. DOE

N89-15251*# Ford Motor Co., Dearborn, MI. Scientific Lab.
IMPROVED SILICON CARBIDE FOR ADVANCED HEAT ENGINES Annual Report
T. J. Whalen and W. L. Winterbottom Sep. 1986 103 p
(Contract NAS3-24384)
(NASA-CR-179477; NAS 1.26:179477) Avail: NTIS HC A06/MF A01 CSCL 11C

Work performed to develop silicon carbide materials of high strength and to form components of complex shape and high reliability is described. A beta-SiC powder and binder system was adapted to the injection molding process and procedures and process parameters developed capable of providing a sintered silicon carbide material with improved properties. The initial effort has been to characterize the baseline precursor materials (beta silicon carbide powder and boron and carbon sintering aids), develop mixing and injection molding procedures for fabricating test bars, and characterize the properties of the sintered materials. Parallel studies of various mixing, dewaxing, and sintering procedures have been carried out in order to distinguish process routes for improving material properties. A total of 276 MOR bars of the baseline material have been molded, and 122 bars have been fully processed to a sinter density of approximately 95 percent. The material has a mean MOR room temperature strength of 43.31 ksi (299 MPa), a Weibull characteristic strength of 45.8 ksi (315 MPa), and a Weibull modulus of 8.0. Mean values of the MOR strengths at 1000, 1200, and 14000 C are 41.4, 43.2, and 47.2 ksi, respectively. Strength controlling flaws in this material were found to consist of regions of high porosity and were attributed to agglomerates originating in the initial mixing procedures. The mean stress rupture lift at 1400 C of five samples tested at 172 MPa (25 ksi) stress was 62 hours and at 207 MPa (30 ksi) stress was 14 hours. New fluid mixing techniques have been developed which significantly reduce flaw size and improve the strength of the material. Initial MOR tests indicate the strength of the fluid-mixed material exceeds the baseline property by more than 33 percent. Author

N89-15252# Aerospatiale, Suresnes (France). Direction de la Qualite.
EVALUATION OF PRIMER COATINGS FOR BONDING. TEST REPORT 48-450 [EVALUATION DES PRIMAIRES DE COLLAGE. PROCES-VERBAL 48-450]
P. Michelin and J. Odorico 20 Aug. 1987 31 p In FRENCH
(Contract STPA-85-96-032)
(Rept-48-450; ETN-89-93606) Avail: NTIS HC A03/MF A01

The degradation of the primer coatings BR 127 and BR 227 after thermal aging simulating bad stock conditions or time limit passing was studied. A correlation between primer degradation and corrosion resistance of the bonded joints was established. The BR 127 shows a degradation of the corrosion resistance after aging during 11 days at 32 C, while for the BR 227 no degradation is found. ESA

N89-15253# Aerospatiale, Suresnes (France). Direction de la Qualite.
STUDY OF THE DEGRADATION PROCESS OF ASSEMBLIES BONDED IN AGRESSIVE ENVIRONMENTS (LIGHT ALLOYS). TEST REPORT 48-455/F [ETUDE DU PROCESSUS DE DEGRADATION DES ASSEMBLAGES COLLES EN AMBIANCE AGRESSIVE (ALLIAGES LEGERS). PROCES-VERBAL 48-455/F]
J. M. Cuntz and J. Odorico 30 Jul. 1987 41 p In FRENCH
(Contract STPA-85-96-032)
(Rept-48-455/F; ETN-89-93607) Avail: NTIS HC A03/MF A01

The degradation of bonded joints of the 2024 aluminum alloy was studied as a function of the preliminary surface treatment, either a sulfochromic treatment or anodic oxidations. Mechanical tests show that the protecting power of an anodic treatment is clearly better. The surface analysis indicates that the bond degradation is developed within the surface oxide layer. ESA

N89-15254# Royal Aerospace Establishment, Farnborough (England).
CRAG TEST METHODS FOR THE MEASUREMENT OF THE ENGINEERING PROPERTIES OF FIBRE REINFORCED PLASTICS
P. T. Curtis, ed. Feb. 1988 110 p
(RAE-TR-88012; RAE-MAT/STR-218; BR107250; ETN-89-93672)
Copyright Avail: NTIS HC A06/MF A01

Test methods (shear, flexure, tensile, compression, fatigue, toughness, physical, environment) for resin matrix composites reinforced with orientated continuous fibers are given. They are valid for all grades of carbon glass and aramid fibers, in both U/D tape and woven fabric forms including mixed fiber hybrid combinations, provided that the failure modes are representative. Epoxy resin matrix systems were used in the development of the methods, but, although confirmatory test evidence is lacking, other resin systems should be equally suitable provided that the composite properties fall within any prescribed test limitations and that valid failure modes are obtained. All multidirectional laminates, including woven fabric laminates, must have their ply orientations and stacking sequence balanced about the mid-plane and the longitudinal axis to ensure axial loading and to prevent rotational, flexural, or off-axis displacements. All laminates should be assessed for quality using an ultrasonic scanning technique. ESA

N89-15255*# College of William and Mary, Williamsburg, VA. Dept. of Chemistry.
SPACE ENVIRONMENTAL EFFECTS ON POLYMERIC MATERIALS Final Technicaal Report, 1 Jun. 1987 - 15 Jun. 1988
Richard L. Kiefer and Robert A. Orwoll 1988 24 p

(Grant NAG1-678)
(NASA-CR-184648; NAS 1.26:184648) Avail: NTIS HC A03/MF A01 CSCL 11B

Two of the major environmental hazards in the Geosynchronous Earth Orbit (GEO) are energetic charged particles and ultraviolet radiation. The charged particles, electrons and protons, range in energy from 0.1 to 4 MeV and each have a flux of 10 to the 8th sq cm/sec. Over a 30 year lifetime, materials in the GEO will have an absorbed dose from this radiation of 10 to the 10th rads. The ultraviolet radiation comes uninhibited from the sun with an irradiance of 1.4 kw/sq m. Radiation is known to initiate chain sission and crosslinking in polymeric materials, both of which affect their structural properties. The 30-year dose level from the combined radiation in the GEO exceeds the threshold for measurable damage in most polymer systems studied. Of further concern is possible synergistic effects from the simultaneous irradiation with charged particles and ultraviolet radiation. Most studies on radiation effects on polymeric materials use either electrons or ultraviolet radiation alone, or in a sequential combination. Author

N89-15256*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ISOMERIC OXYDIPHTHALIC ANHYDRIDE POLYIMIDES
Margaret K. Gerber, J. Richard Pratt, and Terry L. StClair Nov. 1988 19 p
(NASA-TM-101525; NAS 1.15:101525) Avail: NTIS HC A03/MF A01 CSCL 11B

Much of the polyimide research at Langley Research Center has focused on isomeric modification of the diamine component; polyimides having considerably improved processability and adhesion have resulted. The present structure-property study was designed to investigate how isomeric attachment of the three oxydiphthalic anhydride (ODPA) polyimides affects their properties. Each dianhydride, 3,4,3',4'-oxydiphthalic anhydride (4,4'-OPDA,I), 2,3,2',3'-oxydiphthalic anhydride (3,3'-OPDA,II), and 2,3,3',4'-oxydiphthalic anhydride (3,4'-OPDA,III), was reacted with p-phenylenediamine, 4,4'-oxydianiline, 3,3'-diaminodiphenylsulfone, 3,3'-diaminobenzophenone, and 4,4'-bis(3-aminophenoxy)benzophenone in DMAc. The inherent viscosities of the resulting poly(amic acids) were determined. Thermally imidized films were studied for their creasability and solubility, as well as by differential scanning calorimetry (DSC), thermogravimetric analysis (TGA) and wide angle X-ray scattering (WAXS). A comparison of these properties will be made. Author

N89-15257*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
STRENGTH OF HOT ISOSTATICALLY PRESSED AND SINTERED REACTION BONDED SILICON NITRIDES CONTAINING Y2O3
William A. Sanders and Diane M. Mieskowski Jan. 1989 10 p
(NASA-TM-101443; E-4429; NAS 1.15:101443) Avail: NTIS HC A02/MF A01 CSCL 11B

The hot isostatic pressing of reaction bonded Si3N4 containing Y2O3 produced specimens with greater room temperature strengths than those by high pressure nitrogen sintering of the same material. Average room temperature bend strengths for hot isostatically pressed reaction bonded silicon nitride and high pressure nitrogen sintered reaction bonded silicon nitride were 767 and 670 MPa, respectively. Values of 472 and 495 MPa were observed at 1370 C. For specimens of similar but lower Y2O3 content produced from Si3N4 powder using the same high pressure nitrogen sintering conditions, the room temperature strength was 664 MPa and the 1370 C strength was 402 MPa. The greater strengths of the reaction bonded silicon nitride materials in comparison to the sintered silicon nitride powder material are attributed to the combined effect of processing method and higher Y2O3 content. Author

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N89-15258# Naval Research Lab., Washington, DC.
LOW QUALITY FUEL PROBLEMS WITH ADVANCED ENGINE MATERIALS Interim Report, Jun. - Jul. 1987
Robert L. Jones 9 Aug. 1988 25 p
(AD-A199951; NRL-MR-6252) Avail: NTIS HC A03/MF A01 CSCL 11B

The ultra high-power, high-efficiency engines of the future will utilize advanced materials including ceramics, composites, and augmented metals. In many cases, these materials may be subject to corrosion by high temperature gases and molten salt deposits resulting from contaminants (e.g., sodium, sulfur, vanadium) in the fuel or engine air. This Memorandum Report gives a short overview of the state of knowledge that exists today concerning corrosion of ceramics and metals by fuel contaminants, and of possible new avenues for research and materials development. It was originally presented as the Keynote Paper for the Session on Hot-Corrosion, Combustion, and Emissions at the DOE-sponsored Coatings for Advanced Heat Engines Workshop, July 27-30, 1987, Castine, ME. GRA

N89-15259# Air Force Geophysics Lab., Hanscom AFB, MA.
A PROPELLENT AND CHEMICAL SPILL AND DISPERSION MODEL
Phani K. Raj, John A. Morris, and Bruce A. Kunkel 22 Sep. 1988 13 p Presented at the JANNAF Safety and Environment Protection Subcommittee Meeting, Monterey, CA, 23-27 May 1988
(AD-A200025; AFGL-TR-88-0235) Avail: NTIS HC A03/MF A01 CSCL 24A

The defense services transport, store and use many kinds of chemicals including fuels, oxidizers, propellants and weapons related chemicals. Many of these chemicals are volatile and may form dense vapor clouds if they are released into the atmosphere. Depending on the physical properties of the chemical, storage conditions, release conditions and weather conditions different types of vapor clouds may be formed (heavy clouds, aerosol bearing clouds, instantaneous puffs, continuous plumes, etc.). In addition, some of the chemicals may react with ambient moisture. It has been shown in the literature that the behavior of heavy vapor clouds is considerably different from that of neutral density vapor clouds. GRA

29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.

For biological materials see *55 Space Biology.*

N89-15260# Los Alamos National Lab., NM.
A FLIGHT-QUALIFIED RFQ FOR THE BEAR PROJECT
D. L. Schrage, L. M. Young, B. Campbell, J. H. Billen, T. Wangler, J. Stovall, F. A. Martinez, W. Clark, S. Gibbs, and G. Blome et al 1988 5 p Presented at the Linear Accelerator Conference, Williamsburg, VA, 3 Oct. 1988 Prepared in cooperation with Grumman Aerospace Corp., Bethpage, NY and GAR Electroformers, Danbury, CT
(Contract W-7405-eng-36)
(DE89-000369; LA-UR-88-3008; CONF-881049-5) Avail: NTIS HC A02/MF A01

A 1-MeV, 30-mA, low-duty factor, 425-MHz RFQ has been designed and constructed for the BEAR (Beam Experiments Aboard a Rocket) Project by Los Alamos National Laboratory, Grumman Space Systems Division and GAR Electroformers. The design of this 1-m-long lightweight (less than 55 kg) accelerator is unique in

that it was constructed of four copper-plated aluminum quadrants joined longitudinally by a room-temperature electroforming process to produce a monolithic structure. There are no RF, vacuum, or mechanical joints in the vane/cavity region of the accelerator. As part of the design/fabrication process, spark-test, cold, and engineering model RFQs were constructed and tested. The completed flight unit has successfully passed static structural and thermal tests as well as dynamic structural (shake) tests according to the launch, separation, and flight specifications. In addition, the RF field distributions and beam-transport characteristics have been measured and found to satisfy the design requirements. DOE

N89-15261*# Clarkson Univ., Potsdam, NY.
CENTER FOR THE DEVELOPMENT OF COMMERCIAL CRYSTAL GROWTH IN SPACE Annual Report, 1 Sep. 1987 - 31 Aug. 1988
William R. Wilcox 4 Jan. 1989 167 p
(Grant NAGw-976)
(NASA-CR-181356; NAS 1.26:181356) Avail: NTIS HC A08/MF A01 CSCL 22A

The second year of operation of the Center for Commercial Crystal Growth in Space is described. This center is a consortium of businesses, universities and national laboratories. The primary goal of the Center's research is the development of commercial crystal growth in space. A secondary goal is to develop scientific understanding and technology which will improve commercial crystal growth on earth. In order to achieve these goals the Center's research is organized into teams by growth technique; melt growth, solution growth, and vapor growth. The melt growth team is working on solidification and characterization of bulk crystals of gallium arsenide and cadmium telluride. They used high resolution X-ray topography performed at the National Synchrotron Light Source at Brookhaven National Laboratory. Streak-like features were found in the diffraction images of semi-insulating undoped LEC GaAs. These were shown to be (110) antiphase boundaries, which have not been reported before but appear to be pervasive and responsible for features seen via less-sensitive characterization methods. The results on CdTe were not as definitive, but indicate that antiphase boundaries may also be responsible for the double peaks often seen in X-ray rocking curves of this material. A liquid encapsulated melt zone system for GaAs has been assembled and techniques for casting feed rods developed. It was found that scratching the inside of the quartz ampoules with silicon carbide abrasive minimized sticking of the GaAs to the quartz. Twelve floating zone experiments were done. Author

N89-15132# Giessen Univ. (Germany, F.R.). Inst. fuer Genetische.
X!PHOPHORUS AS AN EXPERIMENTAL SYSTEM FOR GENETIC AND BIOLOGICAL DEVELOPMENT STUDIES UNDER MICROGRAVITY CONDITIONS
Markus Schmidt and Fritz Anders *In* ESA, Aquarack: Aim and Possible Research Projects Oct. 1988 p 26-33 Transl. into ENGLISH from Das Aquarack. Rahmendisposition und Moegliche Wissenschaftliche Projekte (Cologne, Fed. Republic of Germany, DFVLR), 1987 p 29-36 Original language document was announced as N88-10472 (For primary document see N89-15129 07-12)
Avail: NTIS HC A05/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 33.50 Deutsche marks

N89-15133# Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
LONG TERM INVESTIGATIONS OF THE GROWTH, METABOLISM, AND REPRODUCTION OF FISH UNDER CONDITIONS CLOSE TO WEIGHTLESSNESS
Rainer Froese *In* ESA, Aquarack: Aim and Possible Research Projects Oct. 1988 p 34-42 Transl. into ENGLISH from Das Aquarack. Rahmendisposition und Moegliche Wissenschaftliche Projekte (Cologne, Fed. Republic of Germany, DFVLR), 1987 p 37-45 Original language document was announced as N88-10473 (For primary document see N89-15129 07-12)
Avail: NTIS HC A05/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 33.50 Deutsche marks

N89-15137# Dornier-Werke G.m.b.H., Friedrichshafen (Germany, F.R.).
LIFE SUPPORT SYSTEMS FOR BIOLOGICAL EXPERIMENTS UNDER WEIGHTLESSNESS IN THE GERMAN AND EUROPEAN SPACE PROGRAMS
Wolfram Lork and Rainer Stoepler *In* ESA, Aquarack: Aim and Possible Research Projects Oct. 1988 p 75-90 Transl. into ENGLISH from Das Aquarack. Rahmendisposition und Moegliche Wissenschaftliche Projekte (Cologne, Fed. Republic of Germany, DFVLR), 1987 p 77-93 Original language document was announced as N88-10477 (For primary document see N89-15129 07-12)
Avail: NTIS HC A05/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 33.50 Deutsche marks

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N89-15262# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Structures and Materials Panel.
AEROSPACE MATERIALS PROCESS MODELLING
Aug. 1988 263 p In ENGLISH and FRENCH Meeting held in Cesme, Turkey, 2-4 Oct. 1987
(AGARD-CP-426; ISBN-92-835-0476-3) Copyright Avail: NTIS HC A12/MF A01

The modeling behavior of metallic materials, and in particular the forming of components such as castings and formings, are discussed. For individual titles, see N89-15263 through N89-15281.

N89-15263# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, OH.
PROCESSING SCIENCE AND MATERIALS DEVELOPMENT
Harold L. Gegel *In* AGARD, Aerospace Materials Process Modelling Aug. 1988 15 p (For primary document see N89-15262 07-31)
Copyright Avail: NTIS HC A12/MF A01

The development of advanced technologies for the fabrication of close-tolerance parts, in conjunction with the development of advanced materials, plays a key role in the design and manufacturing of affordable aerospace systems. New process and product-design concepts must be evolved in parallel with the development of advanced materials for future systems in order to exploit the achievements being made in materials science and to tailor specific properties while simultaneously producing controlled geometrical shapes. A scientific description of production equipment and, in general, physical objects, media, fields, and interface and material-related phenomena requires theoretical models which are capable of predicting the response of the fabricating system to the initial inputs. The design of a product and the corresponding manufacturing process generally requires both deterministic models and expert systems which utilize designer intuition and logic in finding acceptable solutions. Reviewed here are some of the recent developments in process modeling as related primarily to metalworking systems and how they aid in the understanding of the role of computer and human expertise in modern computer-aided engineering (CAE). Author

N89-15264# Military Academy, Ankara (Turkey).
MODELLING OF DEFORMATION AND MICROSTRUCTURAL CHANGES IN P/M RENE 95 UNDER ISOTHERMAL FORGING CONDITIONS
O. Alniak, D. D. Morphy, T. Terada, A. K. Koul, and J-P. Immarigeon (National Aeronautical Establishment, Ottawa, Ontario) *In*

AGARD, Aerospace Materials Process Modelling Aug. 1988 18 p (For primary document see N89-15262 07-31)
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The changes in microstructure induced by forging and their influence on flow strength in hot isostatically pressed P/M Rene 95 as revealed by constant true strain compression tests under simulated isothermal forging conditions are discussed. Results are presented for initially fine (7 micron) and coarse (50 micron) grained compacts tested at temperatures of 1050, 1075 and 1100 C and at strain rates in the range from 10 to the minus 4th powers (-1) to 1 s(-1). Under these tests conditions, both the fine and coarse grained compacts recrystallize and their grain size is refined during flow. This grain refinement gives rise to softening in both materials. Ultimately, their microstructures transform into the same equiaxed fine grained microduplex structure at which point their flow strength becomes identical. Continued deformation at that point produces no further change in grain size or flow strength. Under this steady state regime of deformation, the microduplex grain size and flow strength are independent of the original microstructure but are conditioned by the strain rate at a given temperature. The steady state grain size increases whereas the steady flow strength decreases with a decrease in strain rate and/or an increase in temperature. It is shown how changes in microstructure and flowstrength during isothermal forging can be modelled in P/M Rene 95 compacts by means of established deformation models for predicting peak flow strength, using the steady state deformation data as a boundary condition for the evolution of microstructure and flow strength and a model for deformation-induced recrystallization during forging that has been recently developed for this class of materials. Author

N89-15265# Marmara Research Inst., Gebze (Turkey). Materials Research Dept.

PREDICTION OF TEMPERATURE DISTRIBUTION IN AXISYMMETRIC EXTRUSION

S. Onurlu *In* AGARD, Aerospace Materials Process Modelling Aug. 1988 8 p (For primary document see N89-15262 07-31)
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In extrusion, the knowledge of temperature distribution is helpful in selecting process variables such as speed, initial temperatures and cooling conditions to optimize the process. This study describes a computer-aided numerical technique for the calculation of temperature distribution in the billet, extruded product and tools. The model is based upon Avitzur's spherical velocity field and extended to include transient heat conduction, heat generations and mass transport effects on the basis of local temperatures and strain rates. The finite difference formulation of the problem considers the heat generation and conduction in each time step of the solution. A computer program is developed to solve the problem. Temperature distributions are calculated as a function of time. Predicted temperatures for the extrusion of aluminum alloys AA 2014 and 2024 are compared with experimental data.
Author

N89-15266# University Coll. of Swansea (Wales). Reader in Materials Engineering.

METALLURGICAL MODELLING OF SUPERALLOY DISC ISOTHERMAL FORGINGS

R. W. Evans *In* AGARD, Aerospace Materials Process Modelling Aug. 1988 17 p (For primary document see N89-15262 07-31)
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The metallurgical structure of superalloy aeroengine disc forgings is a complex function of the forging operation parameters and the post forging heat treatment. It is often desirable to obtain certain specific structures in parts of the disc which are, for instance, resistant to crack propagation and this has traditionally been accomplished by means of a series of production trials. This expensive and time consuming procedure can be considerably shortened if the development of microstructure during the forging can be accurately modelled by a suitable computer code. Described here is such a model and its use in the design of isothermal forged components. The model discribed is a fully thermally coupled visco-plastic finite element algorithm. It treats nodal velocities as the basic unknowns and both the mesh geometry and the various metallurgical structural terms are updated by a single step Euler scheme. Facilities are available for ensuring that surface nodes follow die shapes after impingement, that flow is incompressible and that suitable surface friction forces are applied. Throughout the whole forging process (which may involve the re-meshing of severely distorted elements), the metallurgical history of elements is retained so that the effects of subsequent heat treatments can be assessed. Author

N89-15267# Ecole Nationale Superieure des Mines, Valbonne (France). Centre dEtude de Mise en Forme des Materiaux.

A COMPUTER PROGRAM SIMULATING THE HOT FORGING OF METAL POWDER **c26**

E. Wey, C. Levaillant, and J. L. Chenot *In* AGARD, Aerospace Materials Process Modelling Aug. 1988 10 p (For primary document see N89-15262 07-31)
Copyright Avail: NTIS HC A12/MF A01

A computer program for the simulation of hot forging of metal powder was developed using a finite element technique. The constitutive equation for powder behavior includes viscoplastic effects and porosity. The relationship between flow stress and equivalent strain rate is given. This model involves also unilateral contact conditions friction with the dies. A remeshing module permits the calculation of very large deformation with complex dies. This simulation program is applied to the forging of an automotive part. The simulation allows one to optimize the die's geometry to achieve complete densification and good strain range everywhere in the worked piece. Author

N89-15268# Middle East Technical Univ., Ankara (Turkey). Dept. of Metallurgical Engineering.

MICROSTRUCTURES, FLOW PROPERTIES AND PROCESSING OF Ti6242 ALLOY **c26**

Alpay Ankara and Taylan Altan (Ohio State Univ., Columbus.) *In* AGARD, Aerospace Materials Process Modelling Aug. 1988 13 p (For primary document see N89-15262 07-31)
Copyright Avail: NTIS HC A12/MF A01

The physical phenomena that occurs during metal deformation process of Ti 6242 alloy is reviewed. Data on flow properties is obtained by compression tests. Also covered are the flow stress variations with the type of equipment used, deformation heating, effects of temperature, strain, strain rate and microstructural variations. Author

N89-15269# Dayton Univ., OH. Dept. of Mechanical Engineering.

PHYSICAL MODELING AND VISIOPLASTICITY STUDIES OF THE FORGING PROCESS

V. K. Jain and R. Srinivasan (Wright State Univ., Dayton, OH.) *In* AGARD, Aerospace Materials Process Modelling Aug. 1988 13 p (For primary document see N89-15262 07-31)
Copyright Avail: NTIS HC A12/MF A01

An analytical technique, which employs the approach of visioplasticity for evaluating large plastic strains such as those occurring in metalforming, is presented. The distortion of a quadrilateral element of a grid was tracked to compute strains during deformation. Here, two lines of a quadrilateral are used (length before and after deformation and direction cosines before deformation) to determine the true effective strain in the element. Although the method can be applied to any mode of deformation, its application plane-strain deformation is considered. The method has been verified by application to basic cases of deformation such as uniaxial compression, tension, pure shear, and rotation of element. Wedge testing was used for verification of the analytical results of a visco-plastic finite-element program ALPID which was developed to simulate metal flow in deformation processes such as forging and extrusion. Wedge-shaped specimens were machined from plates of 1100-F and 6061-T6 aluminum, and grids were engraved on the meridian plane by means of a CNC engraver. The specimens were annealed and compressed in a channel-shaped segmented die at room temperature. Author

N89-15270# Ecole Nationale Superieure des Mines, Valbonne (France).
SUPERPLASTIC BEHAVIOUR OF SOME Ti-6Al-4V ALLOYS INVESTIGATED BY TORSION TESTING **c26**
Y. Combres, C. Levaillant, and F. Montheillet (Ecole Nationale Superieure des Mines, Sainte-Etienne, France) *In* AGARD, Aerospace Materials Process Modelling Aug. 1988 13 p (For primary document see N89-15262 07-31)
Copyright Avail: NTIS HC A12/MF A01

The work done at CEMEF in the past five years was to compare microstructurally different Ti-6Al-4V alloys and to set down their flow rules for further implementation in computer aided forming process design. Experiments were carried out on a torsion device. Torsion testing is particularly well adapted to the simulation of the forming processes such as rolling or forging. The modeling of isothermal forging and isothermal superplastic bulging are discussed. Author

N89-15271# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Gennevilliers (France).
THE FORGE 2 ISOTHERMAL FORGING MODEL [LE MODELE DE FORGEAGE ISOTHERME FORGE 2] **c26**
P. E. Mosser and Y. Germain *In* AGARD, Aerospace Materials Process Modelling Aug. 1988 11 p In FRENCH; ENGLISH summary (For primary document see N89-15262 07-31)
Copyright Avail: NTIS HC A12/MF A01

A Forge 2 isothermal forging model is described which is based on a fluid-type formulation. The model employs the Tresca (Baque, 1973) friction-law, and is used to determine the friction coefficients. A method of the analysis of the ring test is presented. The isothermal forging variables of the compressor disk are numerically studied for the cases of the forging of actual TA6V specimens and model specimens of a Pb-Sn alloy. Even using simple rheological or tribological laws, the program makes possible the selection of the forging process variables on the basis of criteria such as the texture development and the distribution of deformations. Author

N89-15272# Liege Univ. (Belgium).
COMPUTER PREDICTION OF INTERNAL STRESSES DURING HEAT TREATMENT **c26**
D. Assaker and M. Hogge *In* AGARD, Aerospace Materials Process Modelling Aug. 1988 15 p (For primary document see N89-15262 07-31)
Copyright Avail: NTIS HC A12/MF A01

The problem of determining stresses due to thermal and transformation-induced volume changes during the quenching of hot steel bodies is investigated. Since there is no proper experimental way to determine the local stress field during the heat treatment, a finite element model that addresses this problem is developed, which allows for stress history knowledge and prediction of the residual stress field in the finished body. All thermophysical properties are temperature dependent. In case of steel bodies an additional parameter related to the cooling rate enables to localize microstructure state on a Continuous Cooling Transformation diagram. The efficiency of the model is demonstrated through a detailed computation of stresses in a quenched steel cylinder. Author

N89-15273# Structural Dynamics Research Corp., Milford, OH.
SIMULATION AND DESIGN OF HIGH PRECISION UNIT PROCESSES VIA NUMERICAL METHODS
Roger Stafford *In* AGARD, Aerospace Materials Process Modelling Aug. 1988 21 p (For primary document see N89-15262 07-31)
Copyright Avail: NTIS HC A12/MF A01

SDRC has developed new computer codes specifically tailored for precise and fist simulations of manufacturing processes. Critical aspects of unit processes involve nonlinear transient heat transfer coupled with slow creeping flow. Finite element methods are chosen. Numerical algorithms are adopted which are specifically suited to the problem. Key elements of these simulations are outlined. SDRC has integrated unit process simulations with CAD/CAM design systems, analysis graphics systems, automated inspection, and data base. An example will illustrate data flow, simulation results, and how engineers are using these tools to design new processes for large complex parts. Author

N89-15274# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Mechanical Engineering.
A MIXED EULERIAN-LAGRANGIAN FINITE ELEMENT METHOD FOR SIMULATION OF THERMO-MECHANICAL FORMING PROCESSES
J. Huetink and J. vanderLugt *In* AGARD, Aerospace Materials Process Modelling Aug. 1988 8 p (For primary document see N89-15262 07-31)
Copyright Avail: NTIS HC A12/MF A01

A mixed Eulerian-Lagrangian finite element method is developed by which nodal point locations can be adapted independently from the actual material displacements. Numerical difficulties due to large element distortions, as many occur when the updated Lagrange method is applied, can be avoided by this method. Movement of (free) surfaces can be taken into account by adapting nodal surface points in a way that they remain on the surface. Hardening and other deformation path dependent properties are determined by incremental treatment of convective terms. A local and a weighed global smoothing procedure is introduced in order to avoid numerical instabilities. The method has been applied to simulations of an upsetting process, a wire drawing process and a cold rolling process. In the simulation of the rolling process, both workpiece and roll are simultaneously analyzed in order to predict the flattening of the roll. Special contact-slip elements are developed for the tool-workpiece interface. Author

N89-15275# Middle East Technical Univ., Ankara (Turkey). Dept. of Mechanical Engineering.
FINITE-ELEMENT-SIMULATION OF METAL-FORMING PROCESSES
A. E. Tekkaya *In* AGARD, Aerospace Materials Process Modelling Aug. 1988 13 p (For primary document see N89-15262 07-31)
Copyright Avail: NTIS HC A12/MF A01

For the metal forming industry, numerical simulation procedures, through which the tremendous costs for process development and experimental tools can be reduced, are gaining an increasing significance. Here, a finite element code, based on the well-known elastic-plastic formulation by McMeeking and Rice will be given and some interesting industrial metal forming applications are discussed. The finite element approach is of updated Lagrangian type utilizing a generalized Prandtl-Reuss flow rule together with the v.Mises yield criterion. Nonlinearities resulting from the material response and the complex kinematics of the problem are handled numerically through the self-correcting and the midpoint stiffness methods. Examples of application cover the analysis of residual stresses in extrusion, the simulation of the Sachs boring-out method, as well as the simulation of instabilities and deep-drawing. Author

N89-15276# Argonne National Lab., IL.
GENERIC CASTING MODELING
William T. Sha *In* AGARD, Aerospace Materials Process Modelling Aug. 1988 16 p (For primary document see N89-15262 07-31)
Copyright Avail: NTIS HC A12/MF A01

A detailed model is given of fluid flow coupled with heat transfer of a liquid melt for casting processes. The model is an extension of the COMMIX code and is capable of handling castings of any shape, size, and material. While much of the emphasis is placed on fluid flow and heat transfer, a brief mention of R and D needs in modeling of metallurgical aspects, as well as stress/deformation is also outlined. A feature of this model is the ability to track the liquid/gas interface and liquid/solid interface. It can also calculate alloy element distributions providing that constitutive relations such as interfacial drag between alloy elements are available. The flow of liquid melt through the sprues,

runners, and gates into the mold cavity is calculated, along with three-dimensional temperature and velocity distributions of the liquid melt throughout the casting process. Author

N89-15277# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Gennevilliers (France).
A NUMERICAL MODEL OF DIRECTIONAL SOLIDIFICATION OF CAST TURBINE BLADES
Ghislaine Lamanthe and L. VermotdesRoches *In* AGARD, Aerospace Materials Process Modelling Aug. 1988 5 p (For primary document see N89-15262 07-31)
Copyright Avail: NTIS HC A12/MF A01

A finite element model of the thermokinetics of the directional solidification of cast turbine blades is discussed. The main difficulty to be solved to obtain an appropriate modelling of the phenomenon lies in the high amount of radiative heat transfers, in a case where geometry is complex, thermal gradients high and boundary conditions variable with time. The model treats these transfers by meshing the radiant surfaces and applying shape factors. The other requirements of such an approach are: an appropriate knowledge of the boundary conditions of the furnance, and the thermal properties of materials (ceramic sheils, etc.). Experiments have shown a fair consistency between the thermal fields predicted by the model and temperature data recorded during the solidification of a cluster of complex bars representative of turbine blades. Author

N89-15278# General Electric Co., Cincinnati, OH. Aircraft Engines Dept.
USE OF VENDOR CONSORTIUMS FOR IMPLEMENTATION OF PROCESS SIMULATION TECHNOLOGY
Sulekh C. Jain and Kenneth C. Maddux (Structural Dynamics Research Corp., Milford, OH.) *In* AGARD, Aerospace Materials Process Modelling Aug. 1988 22 p (For primary document see N89-15262 07-31)
Copyright Avail: NTIS HC A12/MF A01

The aerospace Vendor Supplier Industry in the United States is now moving from the Trial and Error approach to the Plan, Predict and Produce philosophy. This new discipline offers reduced development time, near net shapes, improved part quality, reduced inspection, and hence reduced overall cost. The emphasis now is to make it right the first time in the shortest time and at least cost. During the last decade there has been a tremendous amount of progress in the development of fundamental Computer Aided Engineering (CAE) tools for unit manufacturing process simulation. Much of this effort in the United States has been sponsored and funded by the United States Air Force and other government agencies. The tools have been correlated and validated to actual problems in laboratories and shop floors and a reasonable level of confidence and vendor acceptance has been achieved. These tools include simulation for: forging, extrusion, heat treatment, investment casting, ring rolling, chip removal. The challenge now is to implement these tools at vendor sites and to utilize these technologies on an ongoing basis to assist in preventing real world problems. The success and the status of implementation of this technology with major United States aerospace forging vendors are discussed. Author

N89-15279# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Evry Cedex (France).
INDUSTRIAL INTRODUCTION OF THE MODELING OF AERONAUTICAL FORGING AND FOUNDRY PROCESS SIMULATION [INTRODUCTION INDUSTRIELLE DE LA MODELISATION DE SIMULATION DE PROCEDES EN FORGE ET FONDERIE AERONAUTIQUE]
Eric Bachelet and Yves Honnorat *In* AGARD, Aerospace Materials Process Modelling Aug. 1988 9 p In FRENCH (For primary document see N89-15262 07-31)
Copyright Avail: NTIS HC A12/MF A01

Problems encountered in the industrial application of aeronautical forging and foundry process simulation modeling which arise from both the complexity of the processes simulated and the geometries considered are reviewed. It is noted that current three-demensional meshes are useful in modeling complex geometries. Such simulation programs make possible: (1) detailed process analysis; (2) the study of the sensitivity of various fabrication parameters; (3) equipment optimization; and (4) the efficient automation of fabrication. The most advanced modeling integration has been in the industrial production of large axisymmetric forged parts. Author

N89-15280# Inco Engineered Products Ltd., Birmingham (England).
AN APPLICATION OF COMPUTER MODELLING TO ISOTHERMAL FORGING
P. S. Bate *In* AGARD, Aerospace Materials Process Modelling Aug. 1988 10 p (For primary document see N89-15262 07-31)
Copyright Avail: NTIS HC A12/MF A01

In isothermal forging the workpiece is maintained at a reasonably constant temperature throughout the deformation. Because the dies must withstand high temperatures and the process times are long, the method is restricted to the production of high values components. This makes the process inherently expensive and so a reliable simulation in useful for process design. Within certain constraints, mainly those concerned with adequate representations of material behavior, finite element methods can provide such a simulation. The method used to model disc and blade-section forging is described. This is a two-dimensional finite element analysis using a finite incremental/iterative technique for elasto-viscoplastic materials. The mesh is defined by material points, and can be readily redefined during the simulation. Graphical display of the material deformation allows likely problems to be identified. Experiments using simple stress state testing have revealed that commonly used relationships are inadequate for predicting the flow stress of important materials. The type used in the modelling described here attempts an inproved relationship, involving a structure related state variable. The evolution of this variable in the model can, together with experimental simulations, give a reasonable indication of the development of microstructure during forging. Author

N89-15281# Cameron Force Co., Houston, TX.
THE APPLICATION OF PROCESS MODELLING TO HEAT TREATMENT OF SUPERALLOYS **c26**
R. A. Wallis, N. M. Bhathena, P. R. Bhowal, and E. L. Raymond *In* AGARD, Aerospace Materials Process Modelling Aug. 1988 15 p (For primary document see N89-15262 07-31)
Copyright Avail: NTIS HC A12/MF A01

Quenching experiments have been carried out with a flat disk having thermocouples embedded in it. Cooling curves from such tests have provided input data for an inverse heat conduction model which has been used to determine the relationship between the heat transfer coefficient and the part surface temperature for different quenching media. The coefficients obtained have been used in finite element models to predict the temperature and stress distribution within components during heat treatment. The quenching models were validated by trials carried out with instrumented subscale and full size turbine disk forgings. The models have been used to determine the quenching media required to give the cooling rates necessary to meet the property specifications for superalloy components. They have also been used, qualitatively, to reduce the residual stresses developed during quenching with a subsequent reduction in distortion problems during machining. A further application has been the elimination of cracking during the quenching of crack sensitive alloys. Author

N89-15282# Lawrence Livermore National Lab., CA.
DEVELOPMENT OF A HIGH-EFFICIENCY, HIGH-PERFORMANCE AIR FILTER MEDIUM
W. Bergman and S. R. Sawyer 16 Aug. 1988 9 p Presented at the 20th DOE/NRC Nuclear Air Cleaning Conference, Boston, MA, 22 Aug. 1988
(Contract W-7405-eng-48)
(DE88-016280; UCRL-99423; CONF-880815-9) Avail: NTIS HC A02/MF A01

A unique high-efficiency particulate air (HEPA) filter medium has been developed for applications in high temperature and high pressure environments. This filter medium is a composite made from quartz and stainless-steel fibers that have been sintered together. The composite medium has the same efficiency and pressure drop as standard HEPA glass media, but has four times the tensile strength and can operate continuously at temperatures up to 500 C. In a conventional HEPA, the binder burns out above 250 C and the medium loses its strength; our composite filter medium has no comparable loss of strength even at 500 C. DOE

N89-15283# Army Construction Engineering Research Lab., Champaign, IL.
REAL-TIME IMAGING FOR CONSTRUCTION SITE METROLOGY Final Report
Debbie J. Lawrence, Frank W. Kearney, Mark Ginsberg, and Larry Masters Aug. 1988 37 p
(AD-A199909; CERL-TR-M-88/14) Avail: NTIS HC A03/MF A01 CSCL 14B

Military construction, like private industry, needs improved methods by which: (1) quality can be assured throughout the construction process, (2) the degree of construction progress can be assessed and documented, and (3) the performance of systems and materials can be assessed over time to aid in maintenance decision-making. Although these aspects of construction processes have traditionally been addressed through an empirical approach, recent advances in computer technology have provided new opportunities for improving upon the traditional methods. The U.S. Army Construction Engineering Research Laboratory (USA-CERL) is exploring the use of a sequential construction analyzer (SCA) to improve quality assurance, allow for more effective tracking of construction progress, and provide data for making decisions about maintenance. The SCA is a computer-based system that uses images obtained via various types of cameras to enhance the image data into useful information. This study was conducted to identify potential applications of the SCA in three areas of construction: buildings, construction sites, and paving. Many possibilities exist for applying this technology to the construction industry. The SCA concept is being optimized at USA-CERL, and a prototype is under development. When the prototype has been field-tested successfully, it will be used to develop specific applications for the Army and private industry. GRA

N89-15284# Lawrence Livermore National Lab., CA.
DEVICE-ORIENTED QUALITATIVE REASONING FOR DYNAMIC PHYSICAL SYSTEMS
J. F. Macfarlane and Max Donath (Minnesota Univ., Minneapolis.) 27 Jul. 1988 6 p Presented at the ASME Winter Annual Meeting, Chicago, IL, 28 Nov. 1988
(Contract W-7405-eng-48)
(DE89-001123; UCRL-98631; CONF-881120-14) Avail: NTIS HC A02/MF A01

There are few tools to assist the engineer in the initial phase of a design and analysis of a dynamic system. This paper illustrates the utility of a device-oriented qualitative reasoning system as a tool for generating generalized system behavior information which is invaluable information to the designer. For the first time, a qualitative model is presented in terms of its underlying continuous representation. A phase plane analysis, an analysis tool which can only be automated if specific parameter information is defined, is presented for the continuous representation and a qualitative analysis is presented for the qualitative model. The phase plane and state transition diagram, the result of the qualitative analysis, are shown to capture equivalent information. This comparison highlights the ability of qualitative reasoning techniques to provide an automated approach to deriving general system behavior in the absence of specific parameter information. DOE

N89-15285# Illinois Univ., Urbana-Champaign. Dept. of Mechanical and Industrial Engineering.
MEASUREMENTS OF HEAT-TRANSFER COEFFICIENTS OF NONAZEOTROPIC REFRIGERANT MIXTURES CONDENSING INSIDE HORIZONTAL TUBES
D. DeGrush (Oak Ridge National Lab., TN.) and W. F. Stoecker Nov. 1987 129 p
(Contract DE-AC05-84OR-21400)
(DE89-001310; ORNL/Sub-81-7762/6-01) Avail: NTIS HC A07/MF A01

Some preliminary observations from previous system tests on a refrigeration facility using a mixture of R-12/R-114 indicated a reduction in condensing heat-transfer coefficients with the mixture in comparison to either constituent operating alone. Further exploration of this phenomenon involved a glass tube condenser constructed previously for observation of the flow regimes during the condensation process. The study, which is documented by this report, was pursed still further with a copper-tube condenser constructed only for the purpose of measuring heat-transfer coefficients and correlating them with the flow regimes previous observed. In tests that duplicated the flow regimes of the earlier work, the previous results were confirmed in that a low heat-transfer coefficient prevails in the early stage of the condenser, for both a single refrigerant and a mixture. It is in the midrange of the condenser that the mixture experiences its greatest reduction in coefficient in comparison to either constituent. Stratified flow prevails in the midrange of the condenser, so that liquid/vapor slip, if it does occur, would be most prominent in this section. Attempts to measure liquid and vapor concentrations to establish the existence of slip were not successful. From an application standpoint, heat-transfer enhancers such as turbulence promoters should be considered for this midsection of the condenser. DOE

N89-15286*# Eagle Engineering, Inc., Houston, TX.
LUNAR BASE SCENARIO COST ESTIMATES: LUNAR BASE SYSTEMS STUDY TASK 6.1
31 Oct. 1988 294 p
(Contract NAS9-17878)
(NASA-CR-172103; NAS 1.26:172103; EEI-88-211) Avail: NTIS HC A13/MF A01 CSCL 13B

The projected development and production costs of each of the Lunar Base's systems are described and unit costs are estimated for transporting the systems to the lunar surface and for setting up the system. Author

N89-15287*# Eagle Engineering, Inc., Houston, TX.
LUNAR SURFACE CONSTRUCTION AND ASSEMBLY EQUIPMENT STUDY: LUNAR BASE SYSTEMS STUDY (LBSS) TASK 5.3
1 Sep. 1988 206 p
(Contracts NAS9-17878; EEI-TO-87-57)
(NASA-CR-172105; NAS 1.26:172105; EEI-88-194) Avail: NTIS HC A10/MF A01 CSCL 13B

A set of construction and assembly tasks required on the lunar surface was developed, different concepts for equipment applicable to the tasks determined, and leading candidate systems identified for future conceptual design. Data on surface construction and assembly equipment systems are necessary to facilitate an integrated review of a complete lunar scenario. Author

32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

N89-15288 Polytechnic Inst. of New York, Brooklyn.
TOPOLOGICAL PROPERTIES AND DESIGN OF MULTIHOP PACKET RADIO NETWORKS Ph.D. Thesis
Apostolos Konstantin Kakaes 1988 169 p
Avail: Univ. Microfilms Order No. DA8805225

The question of network design of a multihop packet radio network operating under a Code Division Multiple Access protocol with noise threshold theta (CDMA/theta) is examined. Attention is centered on Euclidean random networks in which nodes are placed randomly and links are placed according to some distance sensitive rule. Formulas were established for the expected network path length, the expected total link throughput, and the expected network capacity of an n-node network with network degree d. Finally, the question of improving network capacity by using repeaters is addressed. An upper bound was found on the network capacity which is proportional to the number of nodes n. It is shown how it can be achieved when the number of repeaters is allowed to be arbitrarily large. A heuristic for placing a limited number of repeaters is proposed and evaluated. Dissert. Abstr.

N89-15289 Michigan State Univ., East Lansing.
ELECTROMAGNETIC INTERACTIONS IN INTEGRATED ELECTRONIC CIRCUITS Ph.D. Thesis
Michael John Cloud 1987 102 p
Avail: Univ. Microfilms Order No. DA8807048

Electromagnetic waves in millimeter-wave integrated circuits are studied. Dielectric film and cover regions overlay a conducting half-space in the configuration modeled, forming a nonuniform background for integrated devices. Emphasis is placed upon the microstrip transmission line in this environment. This research exploits an integral-operator description of the system. Constructed through Hertz potentials, an electric field integral equation (IE) quantifies microstrip surface currents. Complex plane analysis in the axial Fourier transform domain leads to the rigorous identification of discrete and continuous eigenvalue spectra. Discrete modes are associated with simple pole singularities, while the continuous spectrum arises from branch-cut integrals. These modal spectra are subsequently linked to natural and forced solutions of the IE. Discrete wave modes are associated with the homogeneous IE, which is solved by the moment method for electrically-thin microstrip. The current density function is expanded in both subsectional and entire-domain basis functions. Results are given and briefly explained. Dissert. Abstr.

N89-15290# Brown Univ., Providence, RI. Lab. for Engineering Man/Machine Systems.
EVENT-SYNCHRONOUS SIGNAL PROCESSING SYSTEM FOR CONNECTED-SPEECH RECOGNIZER
David P. Morgan and Harvey F. Silverman Jan. 1988 17 p
(Grant NSF MIP-85-04277)
(PB88-227590; LEMS-41) Avail: NTIS HC A03/MF A01 CSCL 17B

Speech-source models indicate that event-synchronous feature analysis for a standard real-time speech recognizer (speaker-trained using dynamic programming) should provide a strong basis for improved performance. Among the problems that need to be addressed in implementing such a system are those of developing robust event (pitch, burst, etc.) detectors, synchronous-analysis methodologies, more meaningful feature sets, and algorithms for recognition, e.g., dynamic programming. Descriptions of the current approach to these problems for a left-to-right, connected-word analyzer are given. The event-synchronous system's performance, relative to standard asynchronous methodologies, is presented for easy and difficult vocabularies. Author

N89-15291*# Motorola, Inc., Chandler, AZ. Wideband Communications Section.
THE 300 Mbps MODEM, VOLUME 1 Final Report
Tyrone A. Strozier, Steve Kuh, and Cris Mamaril 5 May 1988 183 p
(Contract NAS5-30095)
(NASA-CR-183407; NAS 1.26:183407) Avail: NTIS HC A09/MF A01 CSCL 17B

The system performance and design of the 300 Mbps Modem development is summarized. In addition, all contract deliverable plans are included. An executive summary of the modem application and capabilities, newly developed technologies, and conclusions of the modem development effort is provided. The theory of operation of the modem is discussed. A detailed parametric performance evaluation of the modem is presented. All subsystem technical specifications are included. Author

N89-15292*# National Aeronautics and Space Administration, Washington, DC.
CONSULTATIVE COMMITTEE FOR SPACE DATA SYSTEMS RECOMMENDATION FOR SPACE DATA SYSTEM STANDARDS: TELECOMMAND. PART 2: DATA ROUTING SERVICE. ARCHITECTURAL SPECIFICATION
Jan. 1987 82 p Prepared in cooperation with CNES, Paris, France, DFVLR, Berlin, Fed. Republic of Germany, ESA, Paris, France, ISRO, Bangalore, India, INPE, Sao Jose dos Campos, Brazil and NASDA, Tokyo, Japan
(NASA-TM-101211; Blue-Book-Issue-1-Pt-2; CCSDS-202.0-B-1-Pt-2; NAS 1.15:101211) Avail: NASA, Washington, DC, Code TS CSCL 17B

A common recommendation is established for the implementation of a spacecraft telecommand data routing service by the agencies participating in the CCSDS. The operating principles and procedures for the CCSDS are defined in a reference. The context of the data routing service within the overall telecommand system is described in another reference. This recommendation addresses the procedures and data unit formats implemented within the segmentation layer and the transfer layer of the telecommand data routing service. Author

N89-15293*# National Aeronautics and Space Administration, Washington, DC.
CONSULTATIVE COMMITTEE FOR SPACE DATA SYSTEMS RECOMMENDATION FOR SPACE DATA SYSTEM STANDARDS: TELECOMMAND. PART 1: CHANNEL SERVICE. ARCHITECTURAL SPECIFICATION
Jan. 1987 38 p Prepared in cooperation with CNES, Paris, France, DFVLR, Berlin, Fed. Republic of Germany, ESA, Paris, France, ISRO, Bangalore, India, INPE, Sao Jose dos Campos, Brazil and NASDA, Tokyo, Japan
(NASA-TM-101210; Blue-Book-Issue-1-Pt-1; CCSDS-201.0-B-1-Pt-1; NAS 1.15:101210) Avail: NASA, Washington, DC, Code TS CSCL 17B

A common recommendation is established which defines the systems architecture of a spacecraft telecommand Channel Service. The intent of this architecture is to provide a common framework within which the agencies participating in the CCSDS may implement compatible future spacecraft telecommanding systems. This recommendation primarily addresses the data unit formats and functions which are implemented within the Coding layer and the physical layers of the CCSDS telecommand channel service. Author

N89-15294*# National Aeronautics and Space Administration, Washington, DC.
CONSULTATIVE COMMITTEE FOR SPACE DATA SYSTEMS RECOMMENDATION FOR SPACE DATA SYSTEM STANDARDS: TELECOMMAND. PART 3: DATA MANAGEMENT SERVICE. ARCHITECTURAL DEFINITION
Jan. 1987 46 p Prepared in cooperation with CNES, Paris, France, DFVLR, Berlin, Fed. Republic of Germany, ESA, Paris, France, ISRO, Bangalore, India, INPE, Sao Jose dos Campos, Brazil and NASDA, Tokyo, Japan

(NASA-TM-101209; Blue-Book-Issue-1-Pt-3; CCSDS-203.0-B-1-Pt-3; NAS 1.15:101209) Avail: NASA, Washington, DC, Code TS CSCL 17B

A common recommendation is established which defines the systems architecture of a spacecraft telecommand data management service. The intent of this architecture is to provide a common framework within which the agencies participating in the CCSDS may implement compatible future spacecraft telecommanding systems. The operating principles and procedures for the CCSDS are defined and the context of the data management service within the overall telecommand system is also described. This recommendation primarily addresses the data unit formats and functions which are implemented within the application process layer, the systems management layer and the packetization layer of the CCSDS telecommand data management service. Author

N89-15295*# National Aeronautics and Space Administration, Washington, DC.

CONSULTATIVE COMMITTEE FOR SPACE DATA SYSTEMS RECOMMENDATIONS FOR SPACE DATA SYSTEM STANDARDS: RADIO FREQUENCY AND MODULATION SYSTEMS. PART 1: EARTH STATIONS AND SPACECRAFT

Jan. 1987 69 p Prepared in cooperation with CNES, Paris, France, DFVLR, Berlin, Fed. Republic of Germany, ESA, Paris, France, ISRO, Bangalore, India, INPE, Sao Jose dos Campos, Brazil and NASDA, Tokyo, Japan

(NASA-TM-101208; Blue-Book-Issue-1-Pt-1; CCSDS-401.0-B-1-Pt-1; NAS 1.15:101208) Avail: NASA, Washington, DC, Code TS CSCL 17B

A set of technical recommendations by CCSDS are presented which are intended for use by participating space agencies in their development of radio frequency and modulation systems for earth stations and spacecraft. The RF and modulation characteristics of spacecraft tracking systems that the CCSDS rpember and observer agencies are planning for the post-1985 time period are broadly described. It is comprised of a multiplicity of tables summarizing the technical characteristics of those systems. Author

N89-15296# Rockwell International Corp., Richardson, TX. Defense Communications.

SPATIAL REUSE THROUGH DYNAMIC POWER AND ROUTING CONTROL IN COMMON-CHANNEL RANDOM-ACCESS PACKET RADIO NETWORKS

James A. Stevens 1 Aug. 1988 181 p

(Contracts N00140-87-R-8903; MDA903-85-C-0205) (AD-A197898; SRNTN-59) Avail: NTIS HC A09/MF A01 CSCL 25B

Topologies of common-channel packet radio networks (PRNETs) are difficult to optimize because some of the links between multiple pairs of packet radio units are not independent. Previous analysis has shown that designing the topology to provide spatial reuse of the common-channel will improve the network throughput and delay performance in general. Unfortunately, the complexity of the link interactions has impeded the design of protocols that can be implemented in operational networks. This dissertation discusses how to optimize the topologies of common-channel random-access PRNETs through dynamic power control at the link layer and routing at the network layer. Methods of implementing dynamic power control at the link layer on an individual packet-by-packet transmission basis are presented. These methods should be implementable at the link layer of any packet radio with dynamic per-packet power control capability. GRA

N89-15297# Pannatoni (Ronald F.), Franklin, NC.

A REVISION OF COUPLED MODE THEORY FOR IRREGULAR ACOUSTIC WAVEGUIDES Final Report, 1983-1987

Ronald F. Pannatoni 8 Aug. 1988 8 p

(Contract N00014-83-C-0230)

(AD-A198466) Avail: NTIS HC A02/MF A01 CSCL 17A

This note concerns new eigenfunction expansions for the fields in an irregular acoustic waveguide. The expansions are associated with a non-selfadjoint eigenvalue problem that has the eigenvalue in some of the boundary conditions. The waveguide consists of two layers of fluid that are separated by a frictionless free interface. The field expansions converge uniformly on both sides of the interface even if the fluid density is discontinuous at the interface. We use the eignefunction expansions to convert the reduced wave equation and the conditions at the boundaries of the waveguide into a system of first-order, ordinary differential equations. These coupling equations are similar to Shevchenko's equations for coupling between local modes in the waveguide. GRA

N89-15298# Rhode Island Univ., Kingston. Dept. of Electrical Engineering.

ESTIMATION OF PARAMETERS OF NON-GAUSSIAN NON-ZERO MEAN AUTOREGRESSIVE PROCESSES WITH APPLICATION TO OPTIMAL DETECTION IN COLORED NOISE Report No. 1, Feb. 1987 - Jun. 1988

Debasis Sengupta and Steven Kay Jun. 1988 39 p

(Contract N00014-87-K-0021)

(AD-A199919) Avail: NTIS HC A03/MF A01 CSCL 12C

The problem addressed in this paper is that of estimating signal and noise parameters from a mixture of Non-Gaussian autoregressive (AR) noise with partially known deterministic signal. Two models are considered in order to examine different kinds of additive mixing. The Cramer-Rao bounds to the joint estimation of the signal amplitude and the noise parameters are presented. A computationally efficient estimator, which was previously proposed for estimation in the absence of signal, is extended for the two models under consideration. The proposed method essentially consists of two stages of least squares (LS) estimation which is motivated by the maximum likelihood estimation (MLE). The technique is then applied to the problem of detecting a signal known except for amplitude in colored non-Gaussian noise. Two slightly different mixing models are used and a generalized likelihood ratio test (GLRT), coupled with the proposed estimation scheme, is used to solve the problems. The results of computer simulations are presented as an evidence of the validity of the theoretical predictions of performance. GRA

N89-15299# Naval Research Lab., Washington, DC.

ADAPTIVE PHASE-SHIFTER NULLING TECHNIQUES FOR LARGE-APERTURE PHASED ARRAYS Interim Report

W. F. Gabriel 15 Aug. 1988 24 p Prepared in cooperation with Sachs/Freeman Associates Inc., Landover, MD

(AD-A199950; NRL-9132) Avail: NTIS HC A03/MF A01 CSCL 09A

Several simple phase-shifter nulling techniques are investigated for application to large-aperture phased arrays to provide a modest, partial adaptive capability at reasonable cost. These techniques do not require auxiliary elements, correlators, or beamformers, but they do require access to the array element phase shifters for injection of small phase perturbations. They also require a priori knowledge of interference source directions to facilitate fast cancellation. Particular aperture ripple modulation algorithms, based on beamspace decomposition principles and adaptive search techniques, are described and applied to computer simulated source situations. For example, by using a 16 element linear array, two strong sources of 5 percent bandwidth were nulled out within about 600 snapshots (range bins) of data; this is remarkably fast for such a simple phase-only adaptive system. The performance results achieved indicate that the concept is feasible and ready for experimental phased-array verification. GRA

N89-15300# Naval Postgraduate School, Monterey, CA.

PASSIVE RANGE ESTIMATION USING OVER SEA MULTIPATH M.S. Thesis

Avner Gal Jun. 1988 126 p

(AD-A199963) Avail: NTIS HC A07/MF A01 CSCL 08C

This thesis suggests an unconventional, unique method for passive range and height estimation of a cruising missile, or other microwave transmitter. Based on multipath propagation, the method uses 5 receiving antennas in a ladder configuration. Ratios of received signal powers are compared with values from lookup

tables to determine the correct location of the transmitter. Computer simulation results are presented, to verify the suggested method. GRA

N89-15301# General Electric Co., Syracuse, NY. Radar Systems Dept.
DIGITAL BEAM STEERING ANTENNA Final Technical Report, Jul. 1984 - Nov. 1987
Louis Eber May 1988 154 p
(Contract F19628-84-C-0105)
(AD-A200030; RADC-TR-88-83) Avail: NTIS HC A08/MF A01 CSCL 09A

A study and evaluation was made of self-calibration techniques applicable to an elemental receiver, digital beamforming receive array requiring precise pattern control (low sidelobes, adaptive nulling, and large dynamic range). A test bed, C-Band, 32-element line array incorporating a novel loop calibration concept was designed and implemented. The test bed array includes 32 elemental receivers with I and Q digital outputs; the array will be used in experiments evaluating the effectiveness of the self-calibration technique. GRA

N89-15302# Defence Science and Technology Organization, Salisbury (Australia). Surveillance Research Lab.
THE CALCULATION OF GROUND WAVE ATTENUATION IN THE HF BAND USING PROGRAM WAGNER
R. M. Thomas and A. O. Zollo Dec. 1987 26 p
(AD-A200049; SRL-0002-TM; DODA-AR-005-341) Avail: NTIS HC A03/MF A01 CSCL 12E

Computational test results from a double precision version of the FORTRAN program WAGNER are presented. The potential value of this integral equation technique is its purported ability to model propagation losses over two-dimensional paths through irregular and inhomogeneous terrain. However the numerical integration algorithm can be affected by poor convergence and inaccuracy, particularly at frequencies above the MF band. We have investigated these properties in terms of selected key parameters and have derived empirical criteria governing convergence and physical accuracy. We find that calculations of basic transmission loss using WAGNER are subject to significant limitations at HF frequencies as the terrain becomes irregular and as the conductivity and dielectric constant of the ground both become smaller. On the other hand, the shadow loss due to an obstacle may be reliably calculated by WAGNER on the assumption that shadow loss is independent of ground electrical constants, thus permitting the use of dummy values of conductivity and dielectric constant to ensure that the physical accuracy criterion is satisfied. GRA

N89-15303# Dayton Univ., OH. School of Engineering.
A HYBRID-ITERATIVE APPROACH FOR RCS MODELING ON SUPER COMPUTERS Final Technical Report, Dec. 1983 - Oct. 1986
G. A. Thiele, P. K. Murthy, and R. P. Penno May 1988 70 p
(Contract F19628-83-K-0034)
(AD-A199349; UDR-TR-86-133; RADC-TR-87-158) Avail: NTIS HC A04/MF A01 CSCL 17I

An iterative method is developed for computing the current induced by plane wave excitation on conducting bodies of arbitrary shape. In this method, the scattering body is divided into lit- and shadow-side regions separated by the geometric optics boundary. An MFIE is written for each region. Each MFIE is solved by iteration (i.e., method of successive substitutions). In order to accomplish this, it is often necessary to have an initial estimate of the shadow side current. This estimate is obtained from edge diffraction theory or Fock theory. Hence, the method is called a hybrid-iterative method (HIM). The HIM is well-suited for use on a super computer like the Cray XMP. Results will be shown for 2-dimensional objects whose size varies from 0.6 wavelengths to 440 wavelengths, all with CPU times under one minute. GRA

N89-15304# Spectra Research Systems, Inc., Irvine, CA.
BISTATIC CLUTTER PHENOMENOLOGICAL MEASUREMENT/MODEL DEVELOPMENT Final Technical Report, Apr. 1986 - Sep. 1987
Charles H. Hightower, David M. Maeschen, and Catherine A. Sanders-Foster May 1988 309 p
(Contract F30602-86-C-0045)
(AD-A199375; SRS-UR88-014; RADC-TR-88-30) Avail: NTIS HC A14/MF A01 CSCL 17I

This program examines the scattering phenomenology of low grazing angle bistatic clutter, as well as specifies the required measurement techniques and instrumentation for its calibrated measurements. Clutter models are proposed for measurement validation techniques. GRA

N89-15305# Illinois Univ., Urbana. Coll. of Engineering.
SIMULTANEOUS DESIGN OF COMMUNICATION STRATEGIES AND CONTROL POLICIES IN STOCHASTIC SYSTEMS Ph.D. Thesis
Rajesh C. Bansal Aug. 1988 219 p
(Grant AF-AFOSR-0174-88)
(AD-A199439; UILU-ENG-88-2244; DC-108) Avail: NTIS HC A10/MF A01 CSCL 12D

This document considers the problem of simultaneously designing communication strategies and control policies in decentralized stochastic systems. Such problems are difficult to solve, mainly because of the nonclassical nature of their information structure. We have identified classes of such problems with linear dynamics, quadratic loss functionals and Gaussian statistics for which the optimality of linear strategies can be established. The general approach used consists of first finding a lower bound on the cost, and then constructing joint strategies that attain this lower bound. For some instances of the cases where linear strategies fail to provide globally optimal solutions, explicit nonlinear strategies are obtained that demonstrate the inferiority of linear designs. The problems studied in this thesis can be viewed as important prototype problems, which are essential building blocks for a general theory of multistage distributed decision making under nonclassical information, and possibly partial statistical description. GRA

N89-15306# Military Academy, West Point, NY.
SPREAD SPECTRUM MULTI-h MODULATION Ph.D. Thesis
William D. Lane Jul. 1988 155 p
(AD-A199473) Avail: NTIS HC A08/MF A01 CSCL 17D

The possibility of communicating reliably by electromagnetic radiation, with only an intended party receiving the message, has long challenged engineers to devise techniques, such as spread spectrum modulation, to combat unintended detection. Coincidentally, the constraints of the electromagnetic spectrum have led to the use of bandwidth and power efficient modulation schemes such as continuous phase modulation and multi-h modulation. The analysis contained herein is the first theoretical and numerical characterization of the combination of direct sequence spread spectrum techniques with multi-h continuous phase modulation; thereby yielding a new class of signals collectively referred to as spread spectrum multi-h (SSMH) modulated signals. By applying a pseudorandom direct spreading sequence to a digital information sequence prior to multi-h modulation, a unique communication scheme is created whereby control over the transmitted spectrum is afforded so as to have a signal with a low probability of intercept by an unintended receiver. In the process of defining and characterizing the signalling structure, it is shown for the first time that the cyclic modulation indices can be applied on either a chip or on a bit interval basis with distinct signal structure and performance differences. It is also shown for the first time that there is a close resemblance between the power spectral densities of the two techniques. GRA

N89-15307# Mitre Corp., Bedford, MA.
EVALUATION OF TROPOSCATTER PROPAGATION IN ICELAND Final Report
M. R. Coirin, A. Fejfar, and J. A. Kessler Aug. 1988 101 p

(Contract F19628-86-C-0001)
(AD-A199504; MTR-10307; ESD-TR-88-267) Avail: NTIS HC A06/MF A01 CSCL 20N

Troposcatter radio links are being considered as a possible way to satisfy some communication needs of the Iceland Air Defense System. This report documents a test program conducted during September and October of 1986 to determine the performance level of digital troposcatter in the Iceland climate. Major emphasis was placed on comparing measurements of path loss and multipath delay spread with predicted values. This comparison was necessary because the models are empirical and contain no data for extreme northern latitudes. The results of these measurements and the ensuing model adjustments are presented. The primary conclusion is that higher system gain than predicted at C-band is required to support troposcatter links in Iceland. GRA

N89-15308# Virginia Univ., Charlottesville. Dept. of Electrical Engineering.
MULTIPLE ACCESS ALGORITHMS FOR A SYSTEM WITH MIXED TRAFFIC: HIGH AND LOW PRIORITY
P. Papantoni-Kazakos 8 Sep. 1988 49 p
(Contract N00014-86-K-0742)
(AD-A199507; UVA/525415/EE89/116) Avail: NTIS HC A03/MF A01 CSCL 25C

A system is considered where a single channel is shared by both high and low priority data. We assume packet transmissions from both data categories and slotted channel. In addition, we assume binary, collision versus noncollision, feedback per slot, and limited feedback sensing capabilities for all users in the system. We assume that the high priority data are generated by a well-defined finite-number user population, while we adopt the limit Poisson User model (infinitely many independent Bernoulli users) for the low priority traffic. For this system, we propose and analyze a transmission algorithm, which is a mixture between a deterministic tree search, for the high priority users, and a random-access algorithm, for the low priority traffic. The algorithm is stable for both traffic classes, it guarantees a strict upper bound on the delays of the high priority packets, and induces good throughput-delay characteristics for the low priority data. GRA

N89-15309# Naval Research Lab., Washington, DC.
SEGMENTATION OF SYNTHETIC APERTURE RADAR (SAR) IMAGES OF OCEAN SURFACE BY THE TEXTURE ENERGY TRANSFORM METHOD Interim Report
Li-Jen Du 17 Aug. 1988 22 p
(AD-A199536; NRL-MR-6259) Avail: NTIS HC A03/MF A01 CSCL 17E

A texture energy transform approach has been chosen for the study of texture analysis and classification in digital images. It is based on the idea of detecting the degree of similarity between the spatial variation of image pixels and a set of chosen mask filters. Feature measures which characterize the texture are simpler to compute as compared with other approaches based on auto-correlation functions, digital transform methods, spatial gray tone co-occurrence probabilities, auto-regression models, etc. An algorithm was developed for the segmentation of SAR ocean surface images into regions with and without directional streaks. Excellent results are obtained in which surface areas with relatively rough and calm water are identified. GRA

N89-15310# Naval Research Lab., Washington, DC.
OVER-THE-HORIZON RADAR DETECTION OF TARGETS VIA SPECULAR SCATTER FROM METEOR TRAILS Interim Report
Roger O. Pilon 27 Sep. 1988 19 p
(AD-A199540; NRL-MR-6348) Avail: NTIS HC A03/MF A01 CSCL 20D

The use of specular scatter from ionized meteor trails for over-the-horizon communications, known as meteor burst communications, has been studied for its applicability to over-the-horizon radar detection of targets. The high propagation losses associated with meteor trails scattering in general require transmitter power-antenna gain products, in excess of 100 dBW, for modest target detection capabilities. Most of the target detection capabilities of meteor trail scattering are available using high-frequency over-the-horizon radar, which generally offers better signal-to-noise ratios and a superior rate of detection. The reradiation pattern of an ionized meteor trail and its unknown orientation combine to introduce extraordinary ambiguities in the target's location with respect to both ground range and azimuthal direction. GRA

N89-15311# Texas Univ., Arlington. Wave Scattering Research Center.
CONDITIONS ON SIMULATION PARAMETERS IN SURFACE SCATTERING Quarterly Report No. 2, Nov. 1987 - Jan. 1988
A. K. Fung and P. M. Chen Jan. 1988 38 p
(Contract N00014-87-K-0751)
(AD-A199591) Avail: NTIS HC A03/MF A01 CSCL 20N

This report is a continuation of the previous study on simulation parameters. Additional cases studied in this report indicate that the minimum number of points per wavelength or per correlation length whichever is the smaller is around 5, the minimum number of surface samples is 25 and the minimum width of the illuminated area is 7 lambda or 7L whichever is the larger. These studies are still incomplete in that we have not considered enough variations in the surface rms height, surface rms slope and the ratio of the incident wavelength to the surface correlation. GRA

N89-15312# Los Alamos National Lab., NM.
CAVITY-WAVEGUIDE COUPLING THROUGH A LARGE APERTURE
T. F. Wang, L. E. Thode, and R. K. Cooper 1988 4 p Presented at the Linear Accelerator Conference, Williamsburg, VA, 3 Oct. 1988
(Contract W-7405-eng-36)
(DE89-000335; LA-UR-88-3261; CONF-881049-15) Avail: NTIS HC A02/MF A01

In designing a high-power, single-feed RF-cavity, one needs to consider the field disturbance caused by the large coupling aperture between the cavity and the waveguide. In this paper, we present an approach for studying this kind of field disturbance for modes in the frequency domain by using the three-dimensional code MAFIA. We demonstrate that by judiciously choosing the boundary conditions at the appropriate location along the waveguide, one can model the cavity-waveguide system by a closed boundary system and reduce the computation time significantly. DOE

N89-15313# Lawrence Livermore National Lab., CA.
SOURCE NEAR-FIELD EFFECTS ON HPM COUPLING
R. J. King and H. G. Hudson Aug. 1988 54 p Sponsored in part by AF
(Contract W-7405-eng-48)
(DE89-001552; UCID-21493) Avail: NTIS HC A04/MF A01

This report is part of an on-going effort to investigate all aspects of the phenomenology of high power microwave (HPM) interactions with systems. Experimental results are given for near-field coupling into generic test systems. While we do not exhaustively answer all of these questions, certain trends are observed. From these, some general conclusions are drawn to guide the use of HPM simulators for testing full systems. DOE

N89-15314# Sandia National Labs., Albuquerque, NM.
COUPLING OF ESD-GENERATED (ELECTROSTATIC DISCHARGES) EMP (ELECTROMAGNETIC PULSE) TO ELECTRONICS
Bill Boverie 1988 13 p Presented at the 10th Annual Electrical Overstress/Electrostatic Discharge Symposium, Anaheim, CA, 27 Sep. 1988
(Contract DE-AC04-76DP-00789)
(DE89-001372; SAND-88-0556C; CONF-880919-1) Avail: NTIS HC A03/MF A01

Electrostatic discharges (ESD) can generate an electromagnetic pulse (EMP) which can couple into electronic circuits. Analytical and experimental models of this coupling demonstrate that, under

some circumstances, the energy coupled to an integrated circuit on a printed circuit board is proportional to the product of the peak E-field and the derivative of the E-field. DOE

N89-15315# Physics and Electronics Lab. TNO, The Hague (Netherlands).
DESIGN AND REALIZATION OF RAT-RACE DIRECTIONAL COUPLERS FOR USE IN A CONSTRAINED FEED OF A PHASED ARRAY X-BAND RADAR ANTENNA
P. A. M. Verheijen Jul. 1987 52 p In DUTCH; ENGLISH summary
(Contract A78/K/040)
(FEL-1987-54; TD-87-4236; ETN-89-93411) Avail: NTIS HC A04/MF A01

Directional hybrid ring couplers and power dividers were designed and realized for use in a planar constrained feed network of array antennas. Configurations in air stripline and in suspended stripline were considered, and theoretically analyzed using S-parameter techniques. Existing models for T-junction discontinuities were verified, and models for more realistic configurations were added. Hybrid ring couplers (so-called rat-race couplers) were realized in an air stripline configuration with coupling values in the X-band from 3 to 6 dB with a 1 dB increment. ESA

N89-15316# Research Inst. of National Defence, Linkoeping (Sweden). Dept. of Information Technology.
MARITIME DATA TRANSMISSION ON HF
Gosta Carlson and Mats Broms May 1988 65 p In SWEDISH; ENGLISH summary
(FOA-C-30496-3.3; ISSN-0347-3708; ETN-89-93544) Avail: NTIS HC A04/MF A01; Research Institute of National Defence, Box 1165, S-581 11 Linkoping, Sweden, 50 Swedish crowns

The limitations of maritime data transmission on HF at 1200 baud are analyzed. Ground wave coverage (the Baltic sea) up to 200 km distance is possible inside a broad frequency range if the ground wave is dominant. Interference between the ionospheric wave and the ground wave limit performance. The frequency choice is very important. Ionospheric wave transmission needs diversity. The performance-limiting of man-made noise and of atmospherics are discussed. ESA

N89-15317# Royal Air Force Coll., Cranwell (England). Dept. of Electrical and Electronic Engineering.
A STUDY OF DIGITAL TRACKING FILTERS M.S. Thesis
S. J. Taylor 1988 197 p Prepared in cooperation with Loughborough Univ. of Technology (England)
(ETN-89-93567) Avail: NTIS HC A05/MF A01

The applications considered include a Track While Scan Radar and an Electronically Steered Array Radar. The theory of tracking filters and trajectories are investigated to determine the performance and limitations that would apply in a real situation. The conclusions are confirmed by a Monte Carlo simulation which gives practical methods to determine filter parameters and performance in a real environment. Best performance results are obtained from filters controlled adaptively to suit the target behavior. ESA

N89-15318# Ecole Nationale Superieure des Telecommunications, Paris (France). Dept. Systemes et Communication.
[ACTIVITIES REPORT IN DATA PROCESSING AND TRANSMISSION FOR THE CNRS UA 820/URA 251, VOLUME 1] Annual Report, 1987 [RAPPORT SCIENTIFIQUE 1987, TOME 1 1987. TRAITEMENT ET COMMUNICATION DE L'INFORMATION CNRS UA 820/URA 251]
Sep. 1988 111 p In FRENCH
(ENST-88D011-Vol-1; ISSN-0751-1345; ETN-89-93622) Avail: NTIS HC A06/MF A01

Research in stochastic systems for modeling and identification applied to networks, discrete structures and algorithms, signal modeling and processing, theory of numerical communication, pattern recognition and voice processing, and architectures for signal processing is summarized. ESA

N89-15319# Ecole Nationale Superieure des Telecommunications, Paris (France). Dept. Systemes et Communications.
[ACTIVITIES REPORT IN DATA PROCESSING AND TRANSMISSION FOR THE CNRS UA 820/URA 251, VOLUME 2] Annual Report, 1987 [RAPPORT SCIENTIFIQUE 1987, TOME 2 1987. TRAITEMENT ET COMMUNICATION DE L'INFORMATION CNRS UA 820/URA 251]
Sep. 1988 56 p In FRENCH
(ENST-88D011-Vol-2; ISSN-0751-1345; ETN-89-93623) Avail: NTIS HC A04/MF A01

Research in image data processing, high resolution images, stereovision, holography, image filters, very large scale integration (VLSI) circuits, computer aided design, and artificial intelligence is reviewed. Modeling and identification applied to networks, discrete structures and algorithms, signal modeling and processing, theory of numerical communication, pattern recognition and voice processing, and architectures for signal processing are discussed. ESA

N89-15320# Royal Signals and Radar Establishment, Malvern (England).
CALCULATION OF THE H-PLANE APERTURE DISTRIBUTION AND FAR FIELD PATTERN FOR A METAL PLATE LOADED HORN
A. H. Lettington and N. J. Hunaban May 1988 12 p
(RSRE-MEMO-4150; BR107538; ETN-89-93663) Copyright Avail: NTIS HC A03/MF A01

Mathematical analysis of the aperture distribution of a horn loaded with a conducting plate is described. The plate improves the H-plane far field pattern of the horn and hence the angular resolution of a passive millimeter wave imager which uses a horn fed antenna. The calculation is based on the Fresnel-Kirchhoff diffraction formula and account is taken of multiple reflections within the horn and from the plate. The resulting H-plane aperture distribution is far from uniform but has a sharp far field pattern. The E-plane distribution remains unchanged by the presence of the plate. ESA

N89-15321# Royal Signals and Radar Establishment, Malvern (England).
MATCHING GROUND IMAGES TO MAP DATA ON MIL-DAP
B. C. Merrifield, P. Simpson, and N. Smith (Logica Ltd., Cobham, England) Jun. 1988 14 p Original contains color illustrations
(RSRE-MEMO-4176; BR107422; ETN-89-93666) Copyright Avail: NTIS HC A03/MF A01

The problem of accurately registering plan views of the ground with maps was programmed for MIL-DAP stand-alone digital array processor, to allow comparative assessment of a programmable implementation. It is concluded that a straightforward implementation on an existing MIL-DAP provides similar size and performance figures to those of prototype dedicated hardware. Although the existing MIL-DAP is more expensive than the custom hardware, cheaper chip set versions are anticipated and such a solution could provide improved mission agility, and lower technical risk, and allow low cost in-service hardware and software updates as the technology advances. ESA

N89-15322# Royal Signals and Radar Establishment, Malvern (England).
EXPERIMENTAL MEASUREMENTS OF SCATTERING FROM SIMPLE WAVELENGTH SIZED PHASED OBJECTS
D. L. Jordan, E. Jakeman, and R. C. Hollins Aug. 1988 21 p
(RSRE-MEMO-4191; BR107744; ETN-89-93667) Copyright Avail: NTIS HC A03/MF A01

The angular distribution of radiation scattered from single deep grooves etched in silicon was studied. There is no discrepancy between the measured angular positions of the diffraction minima from a single deep phase object and those predicted using simple scalar diffraction theory when the probing wavelength is at least

six times smaller than the structure. When however the laser wavelength is increased to become comparable with the structure size complex variations in the amount of scattering with polarization direction and angle of incidence occur. Contrary to expectations based on scattering from conductors, the scattered radiation from the dielectric object studied is greater when the input radiation is p-polarized than when it is s-polarized. Apart from one particular combination of groove depth and angle of incidence where a large unexplained resonance occurs, the ratio of scattered intensities is of order two. The variation of scattered intensity with groove width for widths less than or comparable with the wavelength is consistent with a square law behavior predicted on the basis of a simple scalar approach. ESA

N89-15323# European Space Agency, Paris (France).
PERFORMANCE ANALYSIS AND TUNING OF ERROR CONTROL PROCEDURES IN COMMUNICATION PROTOCOLS
Frank Sausen (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne, Germany, F.R.) Nov. 1988 124 p Transl. into ENGLISH of Leistungsanalyse und Verbesserung von Fehlersicherungsverfahren in Kommunikationsprotokollen (Cologne, Fed. Republic of Germany, DFVLR), Jan. 1987 123 p Original language document was announced as N87-26260
(ESA-TT-1070; DFVLR-FB-87-01; ETN-89-93905) Avail: NTIS HC A06/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 41.50 Deutsche marks

The performance of error control procedures in high speed satellite channels, and an isolated satellite channel were investigated. The tolerable bit error rate was calculated for different throughput requirements and error control procedures. Satellite link protocols which can be switched on and off in the sequencing of blocks were analyzed. Assuming an end-to-end connection with one satellite link, the interaction of Go-Back-N and Selective-Repeat protocols with the ISO transport protocol was determined using queueing network models. Results show that the implementation of a complicated Selective-Repeat protocol only pays off for a small region of the channel performance, and that within an end-to-end connection the correct choice of the time-out value is more critical than the choice of the level-two error control procedure. ESA

N89-15324*# Georgia Inst. of Tech., Atlanta. Electronics and Computer Systems Lab.
NASA-JSC ANTENNA NEAR-FIELD MEASUREMENT SYSTEM Final Technical Report
W. P. Cooke, P. G. Friederich, B. M. Jenkins, C. R. Jameson, and J. P. Estrada Oct. 1988 277 p
(Contract NAS9-17445; GT/GTRI Proj. A-4291)
(NASA-CR-172108; NAS 1.26:172106) Avail: NTIS HC A13/MF A01 CSCL 20N

Work was completed on the near-field range control software. The capabilities of the data processing software were expanded with the addition of probe compensation. In addition, the user can process the measured data from the same computer terminal used for range control. The design of the laser metrology system was completed. It provides precise measruement of probe location during near-field measurements as well as position data for control of the translation beam and probe cart. A near-field range measurement system was designed, fabricated, and tested. Author

N89-15601*# Colorado State Univ., Fort Collins. Dept. of Computer Science.
A VERY LARGE AREA NETWORK (VLAN) KNOWLEDGE-BASE APPLIED TO SPACE COMMUNICATION PROBLEMS
Carol S. Zander *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 401-409 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 17B

N89-15824*# Naval Research Lab., Washington, DC. Center for Space Research.
RADIOWAVE SCATTERING AND ULTRA-LONG-BASELINE INTERFEROMETRY
Brian Dennison *In* NASA, Lyndon B. Johnson Space Center, Future Astronomical Observatories on the Moon Mar. 1988 p 105-112 (For primary document see N89-15810 07-89)
Avail: NTIS HC A07/MF A01 CSCL 20N

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics*.

N89-15325*# California Univ., Los Angeles. Dept. of Electrical Engineering.
ANALOG MOS INTEGRATED CIRCUITS Final Report, 1 Jul. 1985 - 30 Jun. 1988
Gabor C. Temes 28 Nov. 1988 20 p
(Grant NAG2-360)
(NASA-CR-182999; NAS 1.26:182999) Avail: NTIS HC A03/MF A01 CSCL 09C

The goal was to design single-chip lowpass filters with constant group delay in the pass band and 60 dB minimum attenuation in the stop band. The desired 3 dB frequencies are (in Hertz) 2.5, 5, 10, 20, 40, 80, 160, and 320. A filter class that satisfies the constant delay (linear phase) requirement while providing quite a narrow transition band is the Bessel-Chebyshev filters. It was found that the 7th order Bessel-Chebyshev response satisfied the requirement of the filter. Author

N89-15326# Harvard Univ., Cambridge, MA. Div. of Applied Sciences.
JOINT SERVICES ELECTRONICS PROGRAM Annual Progress Report No. 102, 1 Oct. 1987 - 30 Sep. 1988
30 Sep. 1988 198 p
(Contract N00014-84-K-0465)
(AD-A200023) Avail: NTIS HC A09/MF A01 CSCL 09A

This report covers progress made during the past year in the work of eleven Research Units funded under the Joint Services Electronics Program at Harvard University. It is broken down into four major divisions of electronic research: Solid state electronics, Quantum electronics, Information electronics, and Electromagnetic phenomena. Following the report of the work of each unit, there is a complete annual report of the associated Publications, Patents, Presentations, Honors. This report also includes a section on significant accomplishments which contains selected highlights from two of these areas. These are Multiphoton Vibrational Excitation of Molecules by Research Unit 8 and Sensors for Pulses and for Detecting Submarines by Research Unit 11. GRA

N89-15327# Naval Postgraduate School, Monterey, CA.
A CAD MODEL FOR THE INDUCTIVE STRIP IN FINLINE Final Report, 1 Jul. 1987 - 31 Mar. 1988
Jeffrey B. Knorr Aug. 1988 36 p
(AD-A199346; NPS62-88-013) Avail: NTIS HC A03/MF A01 CSCL 09A

This report describes a CAD compatible circuit model for an inductive strip centered in finline with W/b=E sub r2 =1. The circuit model is shown to predict strip scattering coefficients which agree closely with those measured experimentally in X-band. By application of the scaling principle the model is generalized for use with any waveguide size over the normal frequency range for the dominant TE sub 10 mode. GRA

N89-15328# Syracuse Univ., NY. School of Computer and Information Science.
FAULT MODEL DEVELOPMENT FOR FAULT TOLERANT VLSI DESIGN Final Technical Report, May 1986 - May 1987
C. R. Hartmann, P. K. Lala, A. M. Ali, G. S. Visweswaran, and S. Ganguly May 1988 135 p
(Contract F30602-81-C-0169)
(AD-A199350; RADC-TR-88-79) Avail: NTIS HC A07/MF A01 CSCL 09A

Fault models provide systematic and precise representations of physical defects in microcircuits in a form suitable for simulation and test generation. The current difficulty in testing VLSI circuits can be attributed to the tremendous increase in design complexity and the inappropriateness of traditional stuck-at fault models. This report develops fault models for three different types of common defects that are not accurately represented by the stuck-at fault model. The faults examined in this report are: bridging faults, transistor stuck-open faults, and transient faults caused by alpha particle radiation. A generalized fault model could not be developed for the three fault types. However, microcircuit behavior and fault detection strategies are described for the bridging, transistor stuck-open, and transient (alpha particle strike) faults. The results of this study can be applied to the simulation and analysis of faults in fault tolerant VLSI circuits. GRA

N89-15329# State Univ. of New York, Buffalo. Dept. of Chemistry.
PROPAGATORS FOR DRIVEN COUPLED HARMONIC OSCILLATORS
Kyu-Hwang Yeon, Chung-In Um, Woo-Hyung Kahng, and Thomas F. George Sep. 1988 29 p
(Contract N00014-86-K-0043)
(AD-A199418; UBUFFALO/DC/88/TR-83) Avail: NTIS HC A03/MF A01 CSCL 20E

Propagators for coupled and driven coupled harmonic oscillators are evaluated exactly by the path-integral method. The propagators for coupled harmonic oscillators are used to obtain explicitly the energy expectation values. GRA

N89-15330# Sandia National Labs., Albuquerque, NM. Interconnections Div.
DEVELOPING A CONNECTOR SELECTION DEMS USING NIAM (NIJSSEN'S INFORMATION ANALYSIS METHODOLOGY)
Nicole E. Sevier Sep. 1988 20 p
(Contract DE-AC04-76DP-00789)
(DE89-001658; SAND-88-0272) Avail: NTIS HC A03/MF A01

At Sandia there exist over 1200 qualified electrical connectors that an engineer can chose from for a given application. Currently, engineers select a connector from a small group of familiar connectors. This technique may not select the connector which is best suited for the application. To assist engineers in selecting the most suitable connector from those available, a user friendly, menu driven database was required. Nijssen's Information Analysis Methodology (NIAM), a conceptual information modeling technique, was used to characterize the connector data requirements. NIAM gives the designer techniques for gathering, modeling, and analyzing information. The major benefit of the NIAM was the ability to gain acceptance and approval of the conceptual model from management and users. The conceptual model may then be implemented in any specified database management system. This paper will discuss the development of the connector selection database at Sandia using NIAM. DOE

N89-15331# Sheladia Asociates, Inc., Riverdale, MD.
ASSESSMENT OF BATTERY TECHNOLOGIES FOR EV (ELECTRIC VEHICLE) APPLICATIONS
Elliot Z. Ratner, Gary L. Henriksen, and Charles J. Warde (Warde Associates, Inc., Greensboro, NC.) 1988 8 p Presented at the 9th Electric Vehicle Symposium, Toronto, Ontario, 13 Nov. 1988
(Contract DE-AC07-76ID-01570)
(DE88-015226; EGG-M-88117; CONF-881162-1) Avail: NTIS HC A02/MF A01

To guide future R and D program planning, the U.S. Department of Energy (DOE) commissioned an assessment of all viable battery techniques for EV applications. Sixty-seven technology developers in the United States, Canada, Europe, Asia, and Africa were solicited to design a power pack for an Improved Dual-Shaft Electric Propulsions (IDSEP) van. A team of 10 consultants and 8 representatives from DOE's National Laboratories evaluated 43 developer responses and consultant-prepared conceptual designs. Using six criteria---five technical/economic criteria and a maturity/technical barriers criterion---the assessment identified 12 most promising battery technologies. DOE

N89-15332# Argonne National Lab., IL.
FUEL CELLS FOR VEHICLE PROPULSION APPLICATIONS: A PRELIMINARY COMPARISON
R. Kumar, M. Krumpelt, K. M. Myles, and P. A. Nelson 1988 6 p Presented at the 11th Fuel Cell Seminar on Development and Application of Fuel Cells for the 90s, Long Beach, CA, 23 Oct. 1988
(Contract W-31-109-eng-38)
(DE89-000589; CONF-881010-1) Avail: NTIS HC A02/MF A01

Fuel cells are being considered seriously as a potential replacement for internal combustion engines in buses, vans, and ultimately passenger cars. Concern for air quality in urban areas, the possibility of better fuel efficiency, and the prospect of using coal- or biomass-derived alcohols rather than imported oil as fuel are the major motivations. The challenges are to reduce the capital cost of the fuel cell systems and to adapt them for automative use. This study was conducted to make a preliminary comparison of the major types of fuel cells for vehicle propulsion applications. Simplified schematic flow sheets were devised for different fuel cell types. These flow sheets were then used for thermodynamic analyses. Other factors investigated include startup, transient response capability, and system complexity, but no attempt was made to analyze system behavior with reference to any specific driving cycle. For these analyses, fuel cell systems of 60 kWe (gross) were used, equivalent to the approx. 55 kWe battery systems required for advanced electric vans. Four fuel cell types were considered in this study: phosphoric acid (PAFC), proton exchange membrane (PEM), molten carbonate (MCFC), and monolithic acid oxide (MSOFC). Although an experimental van has been successfully operated with an alkaline fuel cell on bottled hydrogen fuel in Europe, this type of fuel cell was not considered in this study. In our view, the alkaline fuel cell is not compatible with alcohol fuels because of the CO2. DOE

N89-15333# Argonne National Lab., IL.
OPPORTUNITIES FOR OPTIMIZING EV BATTERY PERFORMANCE, BATTERY SPECIFIC POWER, AND VEHICLE EQUIVALENT ELECTRICAL CIRCUIT CONSIDERATIONS
W. C. Spindler, R. L. Driggans, and C. C. Christianson 1988 8 p Presented at the 9th Electric Vehicle Symposium Toronto, Ontario, 13 Nov. 1988
(Contract W-31-109-eng-38)
(DE89-000609; CONF-881162-2) Avail: NTIS HC A02/MF A01

This paper addresses the possibilities for improving the interfaces between the battery, drive train, and charger in the design of EVs for commercial fleet uses. It shows that the optimum power condition may occur at about 75 percent of the open circuit voltage rather than the maximum power point of about 50 percent of the open circuit voltage. This paper proposes a need to determine the specifications for battery specific power (W/kg) by taking into account the loss characteristics of the motor and final drive in addition to the battery loss characteristics. DOE

N89-15334# Physics and Electronics Lab. TNO, The Hague (Netherlands).
TESTING OF A NOVEL TYPE OF CONTROL FOR INDUCTION MOTORS
J. W. Stroethoff 1987 20 p In DUTCH; ENGLISH summary
(FEL-1987-41; TD-87-4243; ETN-89-93408) Avail: NTIS HC A03/MF A01

A control method for induction motors in servocontrol systems

was developed in order to avoid the high energy dissipation of the unloaded motor with retention of the dynamic properties of the servocontrol system. The fundamentals of induction motors and the existing control methods are reviewed. The method allows the use of an ac motor with reasonable efficiency in cases where a normal dc servomotor cannot be used; the dynamic properties are good and the lifetime is better than that of a dc motor. ESA

N89-15335*# Sperry Corp., Phoenix, AZ. Aerospace and Marine Group.
MULTI-HUNDRED KILOWATT ROLL RING ASSEMBLY Final Report
Peter E. Jacobson 1 Apr. 1985 122 p
(Contract NAS3-24264)
(NASA-CR-174832; NAS 1.26:174832; S71-5240-1/2-0) Avail: NTIS HC A06/MF A01 CSCL 09C

A program was completed to develop an evaluation unit of a high power rotary transfer device for potential application in a space environment. This device was configured around a Roll Ring concept which performs the same function as a slip ring/brush assembly with a rolling instead of sliding interface. An eight circuit Evaluation Unit (EU) and a portable Test Fixture (TF) were designed and fabricated. The EU was designed to transfer currents to 200 amperes at a potential of as high as 500 volts for an ultimate 100 kW/circuit transfer capability. The EU was evaluated in vacuum at dc transfer currents of 50 to 200 amperes at voltages to 10 volts and at 500 volts at 2 amperes. Power transfer to levels of 2 kW through each of the eight circuits was completed. Power transfer in vacuum at levels and efficiencies not previously achieved was demonstrated. The terminal-to-terminal resistance was measured to be greater than 0.42 milliohms which translates to an efficiency at 100 kW of 99.98 percent. The EU and TF have been delivered to the Lewis Research Center and are being prepared tor testing at increased power levels and for life testing, which will include both dc and ac power. Author

N89-15336*# Varian Associates, Palo Alto, CA. Microwave Tube Div.
DEVELOPMENT OF A 39.5 GHz KARP TRAVELING WAVE TUBE FOR USE IN SPACE Final Report, Jan. 1981 - Jul. 1984
A. Jacquez and D. Wilson Oct. 1988 72 p
(Contract NAS3-23259)
(NASA-CR-182182; NAS 1.26:182182) Avail: NTIS HC A04/MF A01 CSCL 09A

A millimeter-wave TWT was developed using a dispersive, high-impedance forward wave interaction structure based on a ladder, with non-space-harmonic interaction, for a tube with high gain per inch and high efficiency. The 'Tunneladder' interaction structure combines ladder properties modified to accommodate Pierce gun beam optics on a radially magnetized PM focusing structure. The development involved the fabrication of chemically milled, shaped ladders diffusion brazed to each ridge of a double ridged waveguide. Cold-test data are presented, representing the omega-Beta and impedance characteristics of the modified ladder circuit These results were used in small and large-signal computer programs to predict TWT gain and efficiency. A laboratory model tube was designed and fabricated, including all major subassemblies. Author

N89-15337*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
PERFORMANCE OF A MULTISTAGE DEPRESSED COLLECTOR WITH MACHINED TITANIUM ELECTRODES
Peter Ramins and Ben T. Ebihara Jan. 1989 10 p
(NASA-TP-2891; E-4400; NAS 1.60:2891) Avail: NTIS HC A02/MF A01 CSCL 09A

The performance of a multistage depressed collector (MDC) with machined titanium electrodes was evaluated in conjunction with an 800-W, 8- to 18-GHz travelling-wave tube (TWT) and was compared with the performances of geometrically identical copper and isotropic graphite electrode MDC's operated with the same TWT. The titanium electrode MDC produced a modest (about 3 percent) improvement in the MDC and the TWT overall efficiencies as compared with the copper electrode MDC, but its performance was substantially lower than that of the isotropic graphite electrode MDC. Author

N89-15338*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
COMMON SOURCE-MULTIPLE LOAD VS. SEPARATE SOURCE-INDIVIDUAL LOAD PHOTOVOLTAIC SYSTEM
Joseph Appelbaum [1989] 8 p Prepared for presentation at the 4th International Photovoltaic Science and Engineering Conference, Sydney, Australia, 14-17 Feb. 1989; sponsored in part by Inst. of Radio and Electronics Engineers, and New South Wales Univ., Sydney, Australia Prepared in cooperation with Tel-Aviv Univ. (Israel)
(NASA-TM-101465; E-4521; NAS 1.15:101465) Avail: NTIS HC A02/MF A01 CSCL 10B

A comparison of system performance is made for two possible system setups: (1) individual loads powered by separate solar cell sources; and (2) multiple loads powered by a common solar cell source. A proof for resistive loads is given that shows the advantage of a common source over a separate source photovoltaic system for a large range of loads. For identical loads, both systems perform the same. Author

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N89-15339# Massachusetts Inst. of Tech., Cambridge. Dept. of Mathematics.
[TURBULENCE SIMULATIONS] Final Report, 1 Feb. 1983 - 30 Nov. 1984
Steven A. Orszag May 1987 50 p
(Contract F49620-83-C-0064; AF Proj. 2307)
(AD-A191253) Avail: NTIS HC A03/MF A01 CSCL 20D

Work done under AFOSR Contract F49620-83-C-0064 is summarized. The major results include: development of renormalization group techniques for large-eddy simulations of turbulent flows, the first direct numerical simulation of turbulent spots in channel and boundary layer flows, the further development of spectral methods for turbulence simulations, the identification of secondary instability modes in free shear layers, the development of an efficient multi-grid marching method for solution of the parabolized Navier-Stokes equations, a mathematical analysis of boundary conditions for the parabolized compressible Navier-Stokes equations, the further development of a method to improve numerical solution of singular perturbation problems by use of asymptotic approximations. For individual titles, see N89-15340 through N89-15342.

N89-15340# Technion - Israel Inst. of Tech., Haifa. Dept. of Computer Science.
NUMERICAL SOLUTION OF MULTI-DIMENSIONAL DIFFUSION-CONVECTION PROBLEMS BY ASYMPTOTIC CORRECTIONS
M. Israeli and P. Bar-Yoseph *In* MIT, Turbulence Simulations May 1987 5 p (For primary document see N89-15339 07-34) Avail: NTIS HC A03/MF A01 CSCL 20D

The Booster Method for improvement of the numerical solution of partial differential equations by the addition of asymptotic corrections to the right hand side is presented. It is applied here to the diffusion-convection equation for the case of small diffusion. The correction terms were used in finite difference and finite element schemes. The finite element results were used as reference for checking the performance of the finite difference schemes. Excellent results were obtained without the use of

upstreaming or artificial diffusion. Theoretical expectations were confirmed. Author

N89-15341# Massachusetts Inst. of Tech., Cambridge.
RENORMALIZATION GROUP FORMULATION OF LARGE EDDY SIMULATION
V. Yakhot and Steven A. Orszag *In its* Turbulence Simulations May 1987 10 p (For primary document see N89-15339 07-34)
Avail: NTIS HC A03/MF A01 CSCL 20D

Renormalization group (RNG) methods were used to address the solution of the two difficulties encountered by transport modeling. The RNG SGS closures obtained seen to model properly the intersection of turbulent motions in the wall region without ad hoc damping factors, and also appears to account for the generation of random bursts of the buffer layer, without requiring extensive experimental data. The problem of computational work scaling will be addressed. Author

N89-15342# Massachusetts Inst. of Tech., Cambridge.
LECTURES ON SPECTRAL METHODS FOR TURBULENCE COMPUTATIONS
Steven A. Orszag *In its* Turbulence Simulations May 1987 23 p (For primary document see N89-15339 07-34)
Avail: NTIS HC A03/MF A01 CSCL 20D

Several areas of activity in the numerical simulation of transition and turbulence are reviewed. Author

N89-15343 Texas Univ., Austin.
BIFURCATIONS IN STOCHASTIC SYSTEMS AND APPLICATIONS TO SUPERFLUID TURBULENCE Ph.D. Thesis
Mark Franklin Schumaker 1987 155 p
Avail: Univ. Microfilms Order No. DA8806414

A simple model stochastic diffential equation reproduces features of the observations of Griswold, Lorenson and Tough on the transition between turbulent states TI and TII in liquid helium counterflow. The drift component of the model is based on the universal unfolding of the pitchfork bifurcation. A linear noise term models internal fluctuations in the counterflow system. The variance of fluctuations as a function of the heat current is calculated and found to have either one or two maxima depending on the precise form of the unfolding. A modified pitchfork model with a nonlinear noise component reproduces several observations made by the same authors on liquid helium counterflow in the presence of deliberately applied fluctuations of the heat current. This model suggests an explanation for the sharp peak in the probability density observed close to the laminar state in the experiments. A bifurcation diagram constructed from the extrema of the probability distributions is compared with a similar diagram constructed from experimental data. The center manifold reduction and normal form transformations are found to apply to stochastic differential equations in a manner analogous to the treatment of ordinary differential equations. Results are identical to those previously obtained by Knobloch and Wiesenfeld, but the formal manipulations are much simpler. Dissert. Abstr.

N89-15344 Minnesota Univ., Minneapolis.
LASER DOPPLER MEASUREMENTS OF TURBULENCE IN A TWO-DIMENSIONAL WALL JET ON A FLAT PLATE IN STAGNANT SURROUNDINGS Ph.D. Thesis
Mark Edward Schneider 1987 349 p
Avail: Univ. Microfilms Order No. DA8805724

Wall jet flows are of both fundamental and practical interest. The wall jet flow is the simplest flow geometry containing both a free shear layer and a wall boundary layer. In the wall jet these two regions influence each other in ways which are not fully understood and which were difficult to predict with standard fluid mechanics computational models. In this investigation a computer-controlled data acquistion system was designed and constructed to allow automated measurements of velocity correlations in a two-dimensional turbulent wall jet. The measurements were made with a single component laser Doppler velocimeter system. The laser Doppler velocimeter gives repeatable values in this region of the flow and eliminates the bias in hot-wire measurements due to reversing flow and errors in corrections for high turbulence effects. Dissert. Abstr.

N89-15345 Cranfield Inst. of Tech., Bedford (England).
THERMAL-HYDRAULIC DESIGNS OF FINNED HEAT-EXCHANGERS EXPERIENCING FREE OR FORCED CONVECTION Ph.D. Thesis
Shailendra Naik 1987 405 p
Avail: Univ. Microfilms Order No. BRDX81165

The thermal effectiveness of heat transfer equipment, in which the convective resistance constitutes the main barrier to heat flow, can be increased substantially by augmenting the heat-transfer surface with finned or extended surfaces. The design parameters involved in the thermal optimization are investigated for vertical rectangular fins protruding from a horizontal base when situated in an enclosure of infinite dimensions or an almost adiabatic duct of variable cross-sectional area. For a specified fin-array geometry, optimal fin separation, corresponding to the maximum steady-state rate of heat transfer from the heat exchanger, were deduced for the free and forced convective conditions. In addition local and average local and average heat transfers/fluid flows predicted from a three-dimensional forced convection numerical model were correlated to the experimental results. Dissert. Abstr.

N89-15346 New South Wales Univ., Kensington (Australia). School of Mathematics.
TOPICS ON INTERFACIAL AND SURFACE WAVES Ph.D. Thesis
Andrew E. Dixon Dec. 1987 2 p
Avail: Issuing Activity

The effects of a momentum disturbance on the downstream characteristics of a steady, two dimensional flow are investigated. Quantities such as changes in mean depth, mean velocity, mean kinetic and potential energy and the length of the induced downstream wave are examined. The surface response to a simple, stationary surface pressure disturbance on a flow of finite depth is also investigated. The solutions to the problem with linearized boundary conditions are found for a range of depths and length scales of the pressure shape. Simplified solutions are found for a disturbance of asymptotically small and large length. An amplitude equation, describing weak interactions of waves, is derived to describe the time evolution of disturbances on an interface between fluids of differing densities. The equation is analogous to the Zakharov equation for water waves and is used to investigate the stability of a periodic wave. It is found that, for small waveheights, the instabilities are due to resonant quartets. A second instability is found for large perturbation wavenumbers and moderately high waveheights. This is restricted to the case when the Boussinesq parameter is small. This is possibly a Kelvin-Helmholtz instability. Author

N89-15347*# Lockheed Missiles and Space Co., Huntsville, AL. Engineering Center.
DUCT FLOW NONUNIFORMITIES: EFFECT OF STRUTS IN SSME HGM 2+ Final Report
Roger Burke 22 Jun. 1988 50 p
(Contract NAS8-37359)
(NASA-CR-183512; NAS 1.26:183512; LMSC-HEC-TR-F225961)
Avail: NTIS HC A03/MF A01 CSCL 20D

This study consists of an analysis of flow through the Space Shuttle Main Engine (SSME) Hot Gas Manifold (HGM) for the purpose of understanding and quantifying the flow environment and, in particular, the flow through a region of structural supports located between the inner and outer walls of the HGM. The primary task of the study, as defined by NASA-MSFC, is to assess and develop the computational capability for analyzing detailed three-dimensional flow through the HGM support strut region to be incorporated into a full fuelside HGM analysis. Secondarily, computed results are to be compared with available experimental results. Author

N89-15348*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A PHYSICALLY MOTIVATED DOMAIN DECOMPOSITION FOR SINGULARLY PERTURBED EQUATIONS Final Report
Jeffrey S. Scroggs Oct. 1988 17 p Submitted for publication
(Contract NAS1-18605)
(NASA-CR-181734; ICASE-88-62; NAS 1.26:181734) Avail: NTIS HC A03/MF A01 CSCL 20D

A domain decomposition algorithm suitable for the efficient and accurate solution of a parabolic reaction convection diffusion equation with small parameter on the diffusion term is presented. Convergence is established via maximum principle arguments. The equation arises in the modeling of laminar transonic flow. Decomposition into subdomains is accomplished via singular perturbation analysis which dictates regions where certain reduced equations may be solved in place of the full equation, effectively preconditioning the problem. This paper concentrates on the theoretical basis of the method, establishing local and global a priori error bounds. Author

N89-15349# Amtec Engineering, Inc., Bellevue, WA.
THREE-DIMENSIONAL VISCOUS FLOW ANALYSIS FOR MOVING BODIES PAST FIXED STRUCTURES Final Report, 1 Jul. 1987 - 31 Jan. 1988
Kelton T. Peery and Scott T. Imlay 13 May 1988 44 p
(Contract DAAL03-87-C-0012)
(AD-A199982; ARO-25102.1-EG-SBI) Avail: NTIS HC A03/MF A01 CSCL 20D

A prototype computer program has been written to calculate three-dimensional viscous compressible flow past bodies in relative motion. The program solves the Navier-Stokes equations using multiple zones of mesh. During the Phase 1 research and development effort, routines were written to allow the meshes to move and to couple the solutions in adjacent zones along sliding boundaries. The importance of a well planned software structure was demonstrated. The code was applied to a turbine rotor/stator interaction problem. GRA

N89-15350# University of Southern California, Los Angeles. Dept. of Aerospace Engineering.
STUDIES OF UNSTEADINESS IN BOUNDARY LAYERS Annual Technical Report, 1 May 1987 - 30 Apr. 1988
Ron F. Blackwelder, Chih-Ming Ho, Patrick Huerre, and Larry G. Redekopp 13 Jul. 1988 18 p
(Contract F49620-85-C-0080; AF Proj. 2307)
(AD-A199989; AFOSR-88-1138TR) Avail: NTIS HC A03/MF A01 CSCL 20D

Experimental and theoretical efforts aimed at clarifying and revealing important dynamical features of several turbulent shear flows are described. The flows studied include boundary layers, jets, wakes and separated flows on lifting surfaces. Significant progress has been made through experimental studies toward understanding: (1) Unsteady, near wall processes in turbulent boundary layers responsible for the production of turbulent energy; (2) Procedures for enhancing entrainment and mixing in hot jets by passively contouring the jet exit; and (3) Characteristics of boundary layer separation and its control on lifting surfaces in unsteady flows. Theoretical studies on the temporal and spatial structure in blunt body wakes have revealed the necessary conditions under which global, self sustained oscillations appear and have provided firm criteria for specifying the frequency of these oscillations. The theory has been employed to describe the preferred mode in jets. In addition, a theory description of the appearance of the spatial chaos in wake shear layers, and its representation in terms of a one dimensional map, has been provided. GRA

N89-15351*# CCS Associates, Bethel Park, PA.
HEAT PIPE COOLING FOR SCRAMJET ENGINES Final Report
Calvin C. Silverstein Washington NASA Dec. 1986 160 p
(Contract NAS1-17908)
(NASA-CR-4036; NAS 1.26:4036; CCS-115) Avail: NTIS HC A08/MF A01 CSCL 20D

Liquid metal heat pipe cooling systems have been investigated for the combustor liner and engine inlet leading edges of scramjet engines for a missile application. The combustor liner is cooled by a lithium-TZM molybdenum annular heat pipe, which incorporates a separate lithium reservoir. Heat is initially absorbed by the sensible thermal capacity of the heat pipe and liner, and subsequently by the vaporization and discharge of lithium to the atmosphere. The combustor liner temperature is maintained at 3400 F or less during steady-state cruise. The engine inlet leading edge is fabricated as a sodium-superalloy heat pipe. Cooling is accomplished by radiation of heat from the aft surface of the leading edge to the atmosphere. The leading edge temperature is limited to 1700 F or less. It is concluded that heat pipe cooling is a viable method for limiting scramjet combustor liner and engine inlet temperatures to levels at which structural integrity is greatly enhanced. Author

N89-15352# Naval Underwater Systems Center, Newport, RI.
FLUCTUATING WALL PRESSURE AND VIBRATORY RESPONSE OF A CYLINDRICAL ELASTIC SHELL DUE TO CONFINED JET EXCITATIONS Final Report
K. W. Ng 15 Jul. 1988 246 p
(AD-A199528; NUSC-TD-6712) Avail: NTIS HC A11/MF A01 CSCL 20D

A theoretical and experimental study was conducted to investigate the flow-induced noise and vibration caused by confined jet flows in a cylindrical duct. Unrestricted pipe flow and flows restricted by various orifices were tested for a wide range of velocities to simulate the flow in piping systems. Wall pressure data showed that the noise levels vary with the pipe's axial location, and the peak noise is located near the end of the jet potential core. A non-dimensional wall pressure spectrum was established for the various confined jets by the Strouhal relationship, where the length scale is the jet hydraulic diameter. This jet pressure spectrum agrees with the wall pressure spectrum of a turbulent boundary layer above a rigid plane. Correlations of wall pressure fluctuations and pipe wall acceleration signals showed that jet flows generate more deterministic features than pipe flow. The coherent functions of the wall pressure and pipe wall acceleration signals are relatively high near the exit of the jet. The high coherence is probably due to to the large-scale coherent structures. An analytical model was developed to study the effect of the turbulent jet flow field on the wall pressure and vibratory motion of the duct wall. Based on flow field measurements, the blocked surface pressure was calculated using Lighthill's method, and then used to drive the fluid-filled shell. The wall pressure and pipe wall acceleration were determined by solving the coupled fluid-solid interaction problem. GRA

N89-15353# Ballistic Research Labs., Aberdeen Proving Ground, MD.
AXISYMMETRIC CALCULATIONS FOR THE LARGE BLAST/THERMAL SIMULATOR (LB/TS) SHOCK TUBE CONFIGURATION Technical Report, Jan. - Sep. 1986
Dixie M. Hisley and Gregory A. Molvik Sep. 1988 58 p
(AD-A199532; BRL-TR-2935) Avail: NTIS HC A04/MF A01 CSCL 19I

Computational fluid dynamics is a tool which predicts the gas dynamics of blast problems of interest to the Army by solving a set of mathematical equations with a high-speed digital computer. The governing equations for the blast problems presented here are the two-dimensional unsteady Euler equations. The computations were performed on a Cray XMP/48 supercomputer by discretizing the Euler equations with an upwind, Total Variation Diminishing, finite volume, implicit scheme. Details of the scheme are presented in the paper. The algorithm is used here to provide gas dynamic information for a candidate large-scale blast simulator (LBS) concept. A growing need exists for nuclear blast survivability testing of tactical equipment. In order to meet this need, research is conducting into the design and operation of a Large-scale Blast Thermal Simulator, essentially a large multi-driver shock tube. Experiments with heated and unheated driver gas have been performed in a single driver, 1/67 scale model of the LB/TS design

concept but without the thermal simulation (LBS). One dimensional calculations have been performed for the 1/67 scale LBS with useful results. However, the one-dimensional calculations have had limited success for accurately predicting the flow through the diverging portion of the LBS design because the flow in this region is multi-dimensional. The flow is multi-dimensional due to the rapid and large area change that exists in the diverging nozzle. The paper presents results which demonstrates the nature of fluid physics in the 1/57 scale LBS. GRA

N89-15354# Sandia National Labs., Albuquerque, NM.
CTH: A THREE-DIMENSIONAL LARGE DEFORMATION, STRONG SHOCK WAVE PHYSICS CODE
J. M. McGlaun, S. L. Thompson, and M. G. Elrick 1988 10 p
Presented at the Nuclear Explosives Code Developer's Conference, Boulder, CO, 11 Oct. 1988
(Contract DE-AC04-76DP-00789)
(DE89-001185; SAND-88-1597C; CONF-881093-3) Avail: NTIS HC A02/MF A01

CTH is a software system under development at Sandia National Laboratories Albuquerque to model multidimensional, multi-material, large deformation, strong shock wave physics. One-dimensional, two-dimensional, and three-dimensional Eulerian meshes are currently available. CTH uses tabular or analytic equations of state that model solid, liquid, vapor, plasma, and mixed-phase materials. CTH can model elastic-plastic behavior, high explosives, fracture, and motion of fragments smaller than a computational cell. CTH was carefully structured to vectorize and multitask on the CRAY X-MP. Three-dimensional databases reside on the CRAY solid state disk with only five planes in core at once. The input/output to the solid state disk is overlapped with computations so there is no penalty for using the solid state disk. This allows very large problems to be run effectively. A sophisticated post-processor, CTHED, has been developed for interactive analysis using color graphics. This paper describes the architecture, database structure, models, and novel features of CTH. Special emphasis will be placed on the features that are novel to CTH or are not direct generalizations of two-dimensional models. DOE

N89-15355# Lawrence Livermore National Lab., CA.
SOLVING THE INCOMPRESSIBLE NAVIER-STOKES EQUATIONS USING CONSISTENT MASS AND A PRESSURE POISSON EQUATION
Philip M. Gresho and Stevens T. Chan Aug. 1988 25 p
Presented at the Symposium on Recent Developments in Computational Fluid Dynamics, Chicago, IL, 28 Nov. - 2 Dec. 1988
(Contract W-7405-eng-48)
(DE89-001241; UCRL-99406; CONF-881192-1) Avail: NTIS HC A03/MF A01

We derive and demonstrate a new technique for solving the time- dependent incompressible Navier-Stokes equations using low-order (bilinear) finite elements. The scheme is based on using the consistent mass matrix for the physical processes of advection and diffusion, and the lumped mass approximation for the pressure gradient term. The implementation uses a simple semi-implicit projection method based on the original method of Chorin. It is shown that the new scheme is cost-effective, relative to those using either lumped or consistent mass everywhere, especially for simulations in which accuracy of the advective (convective) transport process is particularly important. Steady results obtained from the scheme, which are slightly less accurate, are also addressed. DOE

N89-15356# Lawrence Livermore National Lab., CA.
OPTICAL MAGNIFICATION CORRECTION IN DYNAMIC SIZE MEASUREMENTS FROM REFRACTION AT CONICAL SHOCK FRONTS
D. R. Goosman 20 Sep. 1988 12 p
(Contract W-7405-eng-48)
(DE89-001286; UCRL-53872) Avail: NTIS HC A03/MF A01

An analytical formula is derived for the magnification error in optical size measurements of objects inside conically shaped shock fronts. End detonation of a cylindrically shaped explosive immersed in a fluid necessitates a correction due to refraction at the interface between the shocked and unshocked fluids. It is shown that for detonations immersed in a liquid such as water, the correction factor derived for a conical shock front is significantly larger than the simple correction factor derived if the shock front is assumed to be cylindrical. DOE

N89-15357# Lawrence Livermore National Lab., CA.
SEMI-CONSISTENT MASS MATRIX TECHNIQUES FOR SOLVING THE INCOMPRESSIBLE NAVIER-STOKES EQUATIONS
Philip M. Gresho and Stevens T. Chan Sep. 1988 53 p
Presented at the 1st International Conference on Computational Methods in Flow Analysis, Okayama, Japan, 5 Sep. 1988
(Contract W-7405-eng-48)
(DE89-001299; UCRL-99503; CONF-880936-4) Avail: NTIS HC A04/MF A01

We have described, partially analyzed, and demonstrated three schemes that retain the consistent mass matrix in the Navier-Stokes equations in a cost-effective way relative to either CM everywhere or LM everywhere; viz., by lumping the mass only in the pressure gradient term and solving sequential and uncoupled systems in the context of semi-implicit time integration (implicit for diffusion, explicit for advection) and a pressure Poisson equation. All three deliver nearly the same results as each other and for nearly the same cost as a semi-implicit lumped mass scheme. All three have been shown to be superior to lumped mass methods for flows in which advection accuracy is important. While a relative ranking is difficult, the first of these, PPE, seems to be the worst in that it shows more disadvantages than advantages: (1) it displays an inconsistency at $t = O(+)$, (2) it delivers non-divergence-free solutions that are both larger than those from the equivalent LM scheme and non-vanishing at steady state, (3) it is slightly less stable, and (4) it is slightly more expensive and slightly more dissipative. Its single advantage seems to be in the application of boundary conditions: they are clearly proper and unambiguous. Projection 1 has the disadvantage that even SS results depend on t. While Projection 2 still seems to have somewhat of a theoretical (or perhaps intuitive) edge over Projection 1, in practice the two schemes have been so close that the simplicity and (very slightly) reduced cost of Projection 1 would seem to favor it. Perhaps more effort on Projection 2 would be fruitful, but we are not sure at this time. DOE

N89-15358# Lawrence Livermore National Lab., CA.
AN INVESTIGATION OF THE FINITE ELEMENT INCOMPRESSIBLE FLOW CODE FEM3: THE MODEL, SOME OF ITS OPTIONS, A GUIDE IN HOW TO OBTAIN AND RUN THE CODE, AND ITS PERFORMANCE ON SOME CHOSEN PROBLEMS
R. C. McCallen Sep. 1988 66 p
(Contract W-7405-eng-48)
(DE89-001631; UCID-21527) Avail: NTIS HC A04/MF A01

A review of incompressible flow codes was made to locate codes which would best fit the NTED Thermo-Fluids Group needs. The LLNL code FEM3 was chosen for evaluation. Using the FEM3 code, we have successfully modeled a one-dimensional advection/diffusion problem, the flow over a two-dimensional backward facing step, and the flow through an abrupt expansion in a circular pipe. The FEM3 code accurately predicted these chosen flow problems. Computer time savings and effects on accuracy when running with various solution options were investigated. Also examined were the various boundary condition options. A number of published FEM3 predictions for natural convection problems were reviewed. Since the problems considered were for convection in closed cavities, for which the code behaved very well, the code's ability to accurately and efficiently solve natural convection problems for a heated surface immersed in a fluid has not been determined. Application of the FEM3 code to the chosen problems was found to be straightforward and the existing users manuals gave adequate guidance. A

description of some of the new input options, example input files, along with more detailed guidance to option choices is included in this report. DOE

N89-15359# Argonne National Lab., IL. Materials and Components Technology Div.
SOME ISSUES CONCERNING FLUIDELASTIC INSTABILITY OF A GROUP OF CIRCULAR CYLINDERS IN CROSSFLOW
S. S. Chen Apr. 1988 36 p Presented at the Symposium on Flow Induced Vibration and Noise, Chicago, IL, 28 Nov. 1988
(Contract W-31-109-eng-38)
(DE88-010068; ANL-87-47; CONF-881119-2) Avail: NTIS HC A03/MF A01

Since the early 1970s, extensive studies of fluidelastic instability of circular cylinders in crossflow have been reported. A significant understanding of the phenomena involved now exists. However, some confusion, misunderstanding, and misinterpretation still remain. The objective of this report is to discuss, on the basis of the current state of the art, a series of the most asked questions. Emphasis is placed on the determination of the critical flow velocity, nondimensional parameters, stability criteria, and instability mechanisms. DOE

N89-15360# Los Alamos National Lab., NM.
MODELING TWO-DIMENSIONAL DETONATIONS WITH DETONATION SHOCK DYNAMICS
J. B. Bdzil and D. S. Stewart (Illinois Univ., Urbana.) 1988 29 p Presented at the 6th Army Conference on Applied Mathematics and Computing, Boulder, CO, 31 May 1988
(Contract W-7405-eng-36)
(DE89-000383; LA-UR-88-2906; CONF-8805194-2) Avail: NTIS HC A03/MF A01

In any explosive device, the chemical reaction of the explosive takes place in a thin zone just behind the shock front. The finite size of the reaction zone is responsible for the pressure generated by the explosive being less near the boundaries, for the detonation velocity being lower near a boundary than away from it, and for the detonation velocity being lower for a divergent wave than for a plane wave. In computer models that are used for engineering design calculations, the simplest treatment of the explosive reaction zone is to ignore it completely. Most explosive modeling is still done this way. The neglected effects are small when the reaction zone is very much smaller than the explosive's physical dimensions. When the ratio of the explosive's detonation reaction-zone length to a representative system dimension is of the order of 1/100, neglecting the reaction zone is not adequate. An obvious solution is to model the reaction zone in full detail. At present, there is not sufficient computer power to do so economically. Recently we have developed an alternative to this standard approach. By transforming the governing equations to the proper intrinsic-coordinate frame, we have simplified the analysis of the two-dimensional reaction-zone problem. DOE

N89-15361*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
DIRECT SIMULATION OF AFE FOREBODY AND WAKE FLOW WITH THERMAL RADIATION
James N. Moss and Joseph M. Price Sep. 1988 41 p Presented at the 16th International Symposium on Rarefied Gas Dynamics, Pasadena, CA, 10-16 Jul. 1988 Submitted for publication
(NASA-TM-100673; NAS 1.15:100673) Avail: NTIS HC A03/MF A01 CSCL 20D

Calculated results for the flowfield structure and surface quantities are presented for an axisymmetric representation of an aeroassist flight experiment vehicle. The direct simulation Monte Carlo (DSMC) method is used to perform the calculations, since the flow is highly nonequilibrium about the vehicle during both the compression and expansion phases. The body configuration is an elliptically blunt nose followed by a skirt with a circular radius and an afterbody. Freestream conditions correspond to a single point along the entry trajectory at an altitude of 90 km and a velocity of 9.9 km/s. The calculations account for nonequilibrium in the translational and internal modes, dissociation, ionization, and thermal radiation. The degree of dissociation is large, but the maximum ionization is only about 2 percent by mole fraction. The bluntforebody flow experiences a high degree of thermal nonequilibrium in which the translational temperature is generally greater than the internal temperature. However, as the flow expands about the aerobrake skirt and afterbody, the internal temperature is generally greater than the translational temperature. Author

N89-15362*# Michigan Technological Univ., Houghton. Dept. of Mechanical Engineering.
STRUCTURE OF WIND-SHEAR TURBULENCE Final Report
G. Trevino and T. R. Laituri Washington, DC Jan. 1989 31 p Presented at the 26th Aerospace Sciences Meeting, Reno, NV, Jan. 1988
(Grant NAG1-717)
(NASA-CR-4213; NAS 1.26:4213; AIAA-88-0581) Avail: NTIS HC A03/MF A01 CSCL 20D

The statistical characteristics of wind shear turbulence are modelled. Isotropic turbulence serves as the basis of comparison for the anisotropic turbulence which exists in wind shear. The question of turbulence scales in wind shear is addressed from the perspective of power spectral density. Author

N89-15363# Imperial Coll. of Science and Technology, London (England). Computational Fluid Dynamics Unit.
NUMERICAL BENCHMARK PROBLEMS FOR TWO-PHASE FLOW
D. Brian Spalding May 1988 24 p Presented at the Polymodel 11th Conference, Middlesborough, England, 24-25 May 1988
(CFD/88/3; ETN-89-93575) Avail: NTIS HC A03/MF A01

The need to test rigorously numerical-simulation procedures for two-phase flow is emphasized, and a distinction is made between tests against exact solutions of the equations and tests against experimental data. Attention is confined to the former. A numerical-benchmark exercise is described, and one of the problems included in the exercise, namely that of steady flow in an idealized rocket motor, is presented. It is concluded that numerical-simulation codes can produce good agreement with exact solutions of two phase flow problems, when the grid is sufficiently fine, that some do better than others, and that establishing the reasons for the differences is difficult. ESA

N89-15364# European Space Agency, Paris (France).
NUMERICAL PREDICTION OF MULTIREACTIVE TURBULENT FLOWS BY AN EULERIAN-LAGRANGIAN METHOD
Edith Pourbaix (Office National d'Etudes et de Recherches Aerospatiales, Paris, France) Sep. 1988 86 p Transl. into ENGLISH of Prediction Numerique des Ecoulements Turbulents Multireactifs par une Methode Eulerienne-Lagrangienne (Paris, France, ONERA) Original language document was announced as N84-25959
(ESA-TT-881; ONERA-NT-1983-9; ETN-89-93628) Avail: NTIS HC A05/MF A01

It is shown that in calculating the probability density function (PDF) of mass fractions and temperature in turbomachine combustion, using both classical Eulerian balance equations for mean values and standard deviation, and Lagrangian models, allows a quite realistic approximation of the PDF projection in the phase space (mass fractions and temperature) to be found. This projection consists of just a few curves, even in the case of a multidimensional PDF. Simple integration along these curves provides the different mean values of the flow field. For example, using this method for a premixed air-methane flame allows all the mean characteristic values, at each point of the flame, particularly the mass fractions of methane and CO, and the temperature to be computed. ESA

N89-15365# European Space Agency, Paris (France).
NUMERICAL SIMULATION OF COMPRESSIBLE HOMOGENEOUS TURBULENCE
Philippe Delorme (Office National d'Etudes et de Recherches Aerospatiales, Paris, France) Sep. 1988 118 p Transl. into ENGLISH of Simulation Numerique de Turbulence Homogene

Compressible (Paris, France, ONERA), 1986 49 p Original Language document was announced as N87-18043
(ESA-TT-1030; ONERA-NT-1986-2; ETN-89-93630) Avail: NTIS HC A06/MF A01

In the context of an analysis of homogeneous turbulence, time schemes adapted to the Burgers equation and the Navier-Stokes equations were derived. A Fourier spectral method is used for the space discretization. Applications for two-dimensional (square geometry) and three-dimensional (cubic geometry) cases are described. Simulation of flow with a constant mean velocity field gradient is analyzed and applied to shear flow. Simulations are also presented for cases in which the initial velocity field is a superposition of a mean profile and a turbulent disturbance, approximating a jet type flow. ESA

N89-15366*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
EXPERIMENTAL DETERMINATION OF STATOR ENDWALL HEAT TRANSFER
Robert J. Boyle and Louis M. Russell 1989 21 p Proposed for presentation at the 34th International Gas Turbine and Aeroengine Congress and Exposition, Toronto, Ontario, 4-8 Jun. 1989; sponsored by ASME
(NASA-TM-101419; E-4517; NAS 1.15:101419) Avail: NTIS HC A03/MF A01 CSCL 20D

Local Stanton numbers were experimentally determined for the endwall surface of a turbine vane passage. A six vane linear cascade having vanes with an axial chord of 13.81 cm was used. Results were obtained for Reynolds numbers based on inlet velocity and axial chord between 73,000 and 495,000. The test section was connected to a low pressure exhaust system. Ambient air was drawn into the test section, inlet velocity was controlled up to a maximum of 59.4 m/sec. The effect of the inlet boundary layer thickness on the endwall heat transfer was determined for a range of test section flow rates. The liquid crystal measurement technique was used to measure heat transfer. Endwall heat transfer was determined by applying electrical power to a foil heater attached to the cascade endwall. The temperature at which the liquid crystal exhibited a specific color was known from a calibration test. Lines showing this specific color were isotherms, and because of uniform heat generation they were also lines of nearly constant heat transfer. Endwall static pressures were measured, along with surveys of total pressure and flow angles at the inlet and exit of the cascade. Author

N89-15367 Notre Dame Univ., IN.
TURBULENT BOUNDARY LAYER MODIFICATION BY STREAMLINED DEVICES Ph.D. Thesis
Glenn Alan Gebert 1988 226 p
Avail: Univ. Microfilms Order No. DA8813736

Unsteady aerodynamic theory and the rapid distortion approximation are used to study the modification of turbulent boundary layer large eddy structure by streamlined devices. In response to the fluctuations in the flow, the streamlined device will shed vorticity which induces a velocity field that modifies the turbulent . boundary layer structure. The fluctuating velocity downstream of thin plate and airfoil shaped devices is calculated throughout the boundary layer for subsonic flows with two and three dimensional upstream harmonic disturbance. The results show that such devices most effectively suppress the fluctuating vertical velocity for a range of streamwise reduced frequencies. The intensity and the range of maximum suppression depends on the device geometry, loading, its distance to the wall, as well as the upstream disturbance conditions and the Mach number of the flow. The effect of the wall is shown, and it should be included in the analysis. The results also show that the modifications of the boundary layer are more significant if two devices are used, and if the devices have different chord lengths, and wider range of disturbances can be suppressed. Dissert. Abstr.

N89-15368*# California Polytechnic State Univ., San Luis Obispo. Dept. of Aeronautical Engineering.
THE INFLUENCE OF FREE-STREAM TURBULENCE ON TURBULENT BOUNDARY LAYERS WITH MILD ADVERSE PRESSURE GRADIENTS Final Report, Jan. 1987 - Jan. 1989
Jon A. Hoffmann Nov. 1988 54 p
(Contract NCC2-450)
(NASA-CR-184677; NAS 1.26:184677) Avail: NTIS HC A04/MF A01 CSCL 20D

The influence of near isotropic free-stream turbulence on the shape factors and skin friction coefficients of turbulent bounday layers is presented for the cases of zero and mild adverse pressure gradients. With free-stream turbulence, improved fluid mixing occurs in boundary layers with adverse pressure gradients relative to the zero pressure gradient condition, with the same free-stream turbulence intensity and length scale. Stronger boundary layers with lower shape factors occur as a result of a lower ratio of the integral scale of turbulence to the boundary layer thickness, and to vortex stretching of the turbulent eddies in the free stream, both of which act to improve the transmission of momentum from the free stream to the boundary layers. Author

N89-15369*# California State Univ., Long Beach.
A GENERAL METHOD FOR UNSTEADY HEAT TRANSFER ON TURBINE BLADES Final Report
Tuncer Cebeci and Max F. Platzer (Naval Postgraduate School, Monterey, CA.) Washington NASA Jan. 1989 40 p
(NASA-CR-4206; E-4491; NAS 1.26:4206) Avail: NTIS HC A03/MF A01 CSCL 20D

The development of a general method for calculating unsteady heat transfer on turbine blades is described. It is based on the numerical solution of the boundary-layer equations for laminar, transitional, and turbulent flows. A novel procedure has been developed to account for the movement of the stagnation point caused by blade-passing wakes and has been applied to the stagnation region of three model flows with results which confirm its validity for laminar flows. It has also been applied to an experimental arrangement in which the average Nusselt number has been reported for turbulent flows and the results show considerable promise. Author

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing*. For related information see also *06 Aircraft Instrumentation*, and *19 Spacecraft Instrumentation*.

N89-15370 University of Southern Illinois, Carbondale.
IN SITU MEASUREMENTS OF THE THERMAL PROPERTIES OF HETEROGENEOUS MATERIALS USING TRANSMISSION PHOTOACOUSTIC MICROSCOPY Ph.D. Thesis
Tasdiq Ahmed 1987 123 p
Avail: Univ. Microfilms Order No. DA8805808

Transmission photoacoustic microscopy (TPAM) was developed as an analytical technique for the in-situ measurement of the thermal properties of heterogeneous materials. In TPAM, a modulated light is focused on a polished surface of a heterogeneous material using the objective lens of an optical reflectance microscope. The heat generated at the front or illuminated surface of the sample diffuses to the back surface. This diffusion introduces a phase delay in the temperature of the back surface relative to that of the front surface. The temperature phase delay produces a phase delay in the photoacoustic signal, which is measured by a highly sensitive microphone placed in a closed chamber containing the sample and the coupling gas. The phase of the photoacoustic signal as a function of the modulation frequency constitutes the desired experimental data. Using TPAM, the thermal diffusivities of a rank series of coal were measured.

These thermal diffusivity data were used to calculate the thermal conductivity of coal and to infer the structure of coal as a function of its rank. The TPAM technique was also used to measure the in-situ thermal diffusivities of the constituents of a 3-D carbon-carbon composite material. Thermal diffusivities were measured for the three different yarns in the directions parallel and perpendicular to the fibers. The average thermal diffusivities in the three octagonal directions were measured. Dissert. Abstr.

N89-15371*# California Univ., San Diego. Center for Astrophysics and Space Sciences.
SCIENTIFIC TRADEOFFS IN PINHOLE/OCCULTER FACILITY ACCOMMODATION Final Report
Hugh S. Hudson 16 Dec. 1988 24 p
(Grant NAG8-742)
(NASA-CR-184576; NAS 1.26:184576; SP-88-39) Avail: NTIS HC A03/MF A01 CSCL 14B

The Pinhole/Occulter Facility (P/OF) consists of state-of-the-art instruments for the study of particle acceleration in the solar corona, and uses a large structure to obtain very high angular resolution. P/OF has been studied in the past as an attached payload for the Space Shuttle, and has been the subject of study by a NASA Science Working Group (P/OFSWG). Appendix A lists various technical studies and reports carried out under the auspices of P/OFSWG and the Program Development Office of NASA Marshall Space Flight Center. Under the rationalization of NASA flight opportunities following the Challenger disaster, and the beginning of the Space Station Freedom program, the sortie-mode deployment of P/OF seemed less efficient and desirable. Thus, NASA decided to reconsider P/OF for deployment on the Space Station Freedom. The technical studies for this deployment continue at the present and will evolve as our knowledge of Space Station architecture and capabilities increase. MSFC contracted with Teledyne Brown Engineering for these technical studies.
Author

N89-15372# Sandia National Labs., Albuquerque, NM.
STATE OF THE RESEARCH WORKS ON PVDF PIEZOELECTRIC POLYMER STRESS GAUGES
F. Bauer, R. A. Graman, L. M. Lee, and G. Samara 1988 5 p Presented at the 2nd International Conference on Mechanical and Physical Behavior of Materials Under Dynamic Loading, Ajaccio, France, 19 Sep. 1988 Prepared in cooperation with Institut Franco-Allemand de Recherches de Saint-Louis, 68 (France).
(Contract DE-AC04-76DP-00789)
(DE88-017114; SAND-88-1760C; CONF-880940-3) Avail: NTIS HC A02/MF A01

The research work presented here shows the progress realized in the studies of the ferroelectric and piezoelectric properties of Polyvinylidene Flouride (PVDF). An attempt has been made to understand the fundamental phenomena of the mechanism responsible for the functioning of the shock loaded ferroelectric PVDF. Fundamental questions have not yet found a sufficient response. The main parameter which must be taken into account in the standardization process, is the polarization which is fixed at a value of 9.15 + or - 0.15 microC/sq cm. There are different PVDF, but it seems clear that there is only one piezoelectric PVDF which can be used for shock gauge transducers. DOE

N89-15373# Naval Research Lab., Washington, DC.
DEVELOPMENTS IN HOT-FILM ANEMOMETRY MEASUREMENTS OF HYDROACOUSTIC PARTICLE MOTION Final Report, Jan. 1986 - Sep. 1987
Pieter S. Dubbelday, Virgil V. Apostolico, and Dean L. Diebel 30 Aug. 1988 25 p
(AD-A199332; NRL-MR-6188) Avail: NTIS HC A03/MF A01 CSCL 14B

Hot film anemometry may be used to measure particle motion in hydroacoustic fields. Since the cylindrical sensors used thus far are very fragile, the method is little suited for use outside the laboratory. The measurement of the response of a more rugged conical sensor is reported here. Another way of protecting the sensor consists of packaging the sensor in a rubber liquid filled boot. This also prevents fouling and bubble formation on the heated film. The response shows a resonance at low frequency, ascribed to the liquid filled boot, which may be used for enhanced response in a limited frequency region. The response of a hot film anemometer to vertical hydroacoustic particle motion is influenced by free convection, which acts as a bias flow. The output was shown to be proportional to particle displacement for a wide range of parameters. It was expected that an imposed bias flow would increase the output and remove the dependence on the direction of gravity. Therefore, a hot-film sensor (diameter d) was subjected to an underwater jet from a nozzle. The output showed a transition from being proportional to particle speed, to being proportional to particle displacement, depending on the angular frequency omega and imposed flow speed omega. The transition takes place when a dimensionless number omega, defined as omega = omega/nu is of order 1. GRA

N89-15374# Ballistic Research Labs., Aberdeen Proving Ground, MD.
BRL (BALLISTIC RESEARCH LABORATORY) CALIBRATION PROCEDURES FOR BALLISTIC PRESSURE TRANSDUCERS
Charles D. Bullock and Arpad A. Juhasz Jun. 1988 35 p
(AD-A199372; BRL-TR-2930) Avail: NTIS HC A03/MF A01 CSCL 09A

Current procedures used for the calibration of ballistic pressure transducers at the Ballistic Research Laboratory (BRL) are described. Checks include evaluation of continuity, hysteresis, and zero return characteristics as well as calibration against a dead weight system. Static versus dynamic response behavior is evaluated with the aid of a high pressure dynamic positive step calibrator. For the most exacting measurements, adapters are used permitting calibration of transducers in the same mechanical environment as during measurement. Recommended recalibration intervals are indicated. GRA

N89-15375# Oak Ridge National Lab., TN.
HIGH BRIGHTNESS SOURCES FOR MeV MICROPROBE APPLICATIONS
P. M. Read, G. D. Alton, and J. T. Maskrey 1987 15 p Presented at the 1st International Conference on Nuclear Microprobe Technology and Application, Oxford, United Kingdom, 1 Sep. 1987 Prepared in cooperation with United Kingdom Atomic Energy Authority, Harwell
(Contract DE-AC05-84OR-21400)
(DE88-017365; CONF-8709351-1) Avail: NTIS HC A03/MF A01

State of the art MeV ion microprobe facilities are now approaching current density limitations on targets imposed by the fundamental nature of conventional gaseous ion sources. With a view to addressing this problem, efforts are under way which have the ultimate objective of developing high brightness Li liquid metal ion sources suitable for MeV ion microprobe applications. Prototype Li (+) nd and Ga (+) liquid metal ion sources have been designed, fabricated and are undergoing preliminary testing. This paper describes the first total emittance and brightness measurements of a Ga liquid metal ion source. The effect of the geometry of the ion extraction system is investigated and the brightness data are compared to those of a radio frequency ion source. DOE

N89-15376# Lawrence Livermore National Lab., CA.
A COMPARISON OF FLAT-FIELD MEASUREMENT TECHNIQUES FOR OPTICAL STREAK CAMERAS
D. S. Montgomery and J. D. Wiedwald Aug. 1988 6 p Presented at the 32nd International Technical Symposium on Optical and Opto-electronic Applied Sciences and Engineering, San Diego, CA, 14 Aug. 1988
(Contract W-7405-eng-48)
(DE89-001298; UCRL-99468; CONF-880887-24) Avail: NTIS HC A02/MF A01

A technique for calibrating the flat-field response and geometric distortion of optical steak cameras using high-power lasers and electro-optic pulse shaping hardware was reported previously. The laser hardware provides a temporally-flat light pulse that can be

used to calibrate streak cameras operating with sweep durations of 3 to 10 ns. Although this technique is successful, the hardware involved is expensive and the process is complex. Based on the analysis of calibrations made at these fast sweep rates, we developed a new technique to measure the flat-field response of an optical streak camera using an array of visible light emitting diodes (LED) and a slow (approx. 10 microsecs) sweep generator. We will discuss the new slow technique, and will present a comparison between calibration measurements made using the two techniques. DOE

N89-15377# Naval Research Lab., Washington, DC.
NONLINEAR THEORY OF PHASE LOCKING GYROTRON OSCILLATORS DRIVEN BY AN EXTERNAL SIGNAL Interim Report, Jan. - Dec. 1987
A. W. Fliflet and W. M. Manheimer 15 Jul. 1988 53 p
(AD-A198675; NRL-MR-6180) Avail: NTIS HC A04/MF A01 CSCL 09A

A time-dependent slow time scale theory is developed for gyrotron oscillators driven by an external signal. The signal is introduced either directly into the cavity output or via a beam prebunching cavity. The theory is applied to a high voltage gyrotron configuration and the numerical, nonlinear calculations are compared with simple analytical estimates of the frequency bandwidth for phase-locked operation. For the case of direct injection, the non-linear slow time scale calculations are in good agreement with Adler's relation. Two approaches are investigated for the case of phase-locking with a prebunching cavity. In the first, the induced as current density due to the prebunching cavity is treated as a small perturbation of the as current density in the oscillator. In this approach the equations for the time-dependent wave amplitude and phase are similar in structure to the equations for gyrotrons driven by direct injection, leading to a simple analytical estimate of the locking band width. The accuracy of the perturbation approach is investigated by comparing it with the results of an alternate approach used in the analysis of Gyroklystrons. The maximum phase locking bandwidth obtainable is discussed.
GRA

N89-15378# European Space Agency, Paris (France).
HOLOGRAPHIC DETERMINATION OF DROPLET DISTRIBUTIONS
Klaus Rath, Herbert Wiegand, and Adolf Winandy (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne, Germany, F.R.) Nov. 1988 28 p Transl. into ENGLISH of Holographische Bestimmung von Tropfengroessenverteilungen (Cologne, Fed. Republic of Germany, DFVLR), 1988 Original language document was announced as N88-28250
(ESA-TT-1121; DFVLR-Mitt-88-05; ETN-89-93909) Avail: NTIS HC A03/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 13 Deutsche marks

Techniques of measuring the performance of a liquid spray diffusor are investigated with pulsed laser holography. A hologram produced by the inline method is evaluated in two planes to droplet size and droplet distribution. Only a few large droplets have a considerable part in the complete volume of the atomized fluid.
ESA

N89-15379* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
FLUIDIC MOMENTUM CONTROLLER Patent
Ronald S. Maynard, inventor (to NASA) 11 Oct. 1988 11 p Continuation of US-Patent-Appl-SN-779742, filed 24 Sep. 1985, abandoned
(NASA-Case-MSC-20906-2; US-Patent-4,776,541; US-Patent-Appl-SN-021569; US-Patent-Class-244-165; US-Patent-Class-74-572; US-Patent-Class-244-164) Avail: US Patent and Trademark Office CSCL 14B

Large angular control moments and torques are developed by controllably circulating a relatively small mass of liquid through small diameter pipes describing a large diameter loop. The loop, by generating and storing angular momentum, can thereby provide efficient cancellation of periodic, non-accumulating, externally induced rotational disturbances. The loop is preferably located on or near the periphery of a structure which is to be stabilized.
Official Gazette of the U.S. Patent and Trademark Office

N89-15380*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
TECHNIQUE FOR TEMPERATURE COMPENSATION OF EDDY-CURRENT PROXIMITY PROBES
Robert M. Masters Jan. 1989 10 p
(NASA-TP-2880; E-4316; NAS 1.60:2880) Avail: NTIS HC A02/MF A01 CSCL 14B

Eddy-current proximity probes are used in turbomachinery evaluation testing and operation to measure distances, primarily vibration, deflection, or displacment of shafts, bearings and seals. Measurements of steady-state conditions made with standard eddy-current proximity probes are susceptible to error caused by temperature variations during normal operation of the component under investigation. Errors resulting from temperature effects for the specific probes used in this study were approximately 1.016 x 10 to the -3 mm/deg C over the temperature range of -252 to 100 C. This report examines temperature caused changes on the eddy-current proximity probe measurement system, establishes their origin, and discusses what may be done to minimize their effect on the output signal. In addition, recommendations are made for the installation and operation of the electronic components associated with an eddy-current proximity probe. Several techniques are described that provide active on-line error compensation for over 95 percent of the temperature effects.
Author

N89-15381*# Vigyan Research Associates, Inc., Hampton, VA.
A HIGH SPEED DATA ACQUISITION AND ANALYSIS SYSTEM FOR TRANSONIC VELOCITY, DENSITY, AND TOTAL TEMPERATURE FLUCTUATIONS
Steven J. Clukey Dec. 1988 143 p
(Contract NAS1-17919)
(NASA-CR-181758; NAS 1.26:181758) Avail: NTIS HC A07/MF A01 CSCL 14B

The high speed Dynamic Data Acquisition System (DDAS) is described which provides the capability for the simultaneous measurement of velocity, density, and total temperature fluctuations. The system of hardware and software is described in context of the wind tunnel environment. The DDAS replaces both a recording mechanism and a separate data processing system. The data acquisition and data reduction process has been combined within DDAS. DDAS receives input from hot wires and anemometers, amplifies and filters the signals with computer controlled modules, and converts the analog signals to digital with real-time simultaneous digitization followed by digital recording on disk or tape. Automatic acquisition (either from a computer link to an existing wind tunnel acquisition system, or from data acquisition facilities within DDAS) collects necessary calibration and environment data. The generation of hot wire sensitivities is done in DDAS, as is the application of sensitivities to the hot wire data to generate turbulence quantities. The presentation of the raw and processed data, in terms of root mean square values of velocity, density and temperature, and the processing of the spectral data is accomplished on demand in near-real-time- with DDAS. A comprehensive description of the interface to the DDAS and of the internal mechanisms will be prosented. A summary of operations relevant to the use of the DDAS will be provided.
Author

N89-15130# Ruhr Univ., Bochum (Germany, F.R.). Arbeitsgruppe fuer Verleichende Endokrinologie.
THE AQUARACK AS A POTENTIAL INSTRUMENT FOR FUNDAMENTAL BIOLOGICAL RESEARCH IN SPACE: INVENTORY AND SCIENTIFIC DISPOSITIONS
Volker Bluem *In* ESA, Aquarack: Aim and Possible Research Projects Oct. 1988 p 7-15 Transl. into ENGLISH from Das Aquarack. Rahmendisposition und Moegliche Wissenschaftleche

Projekte (Cologne, Fed. Republic of Germany, DFVLR), 1987 p 9-18 Original language document was announced as N88-10470 (For primary document see N89-15129 07-12)
Avail: NTIS HC A05/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 33.50 Deutsche marks

N89-15823*# New Mexico Univ., Albuquerque. Inst. for Astrophysics.
MERI: AN ULTRA-LONG-BASELINE MOON-EARTH RADIO INTERFEROMETER
Jack O. Burns *In* NASA, Lyndon B. Johnson Space Center, Future Astronomical Observatories on the Moon Mar. 1988 p 97-104 Sponsored in part by Los Alamos National Lab. (For primary document see N89-15810 07-89)
Avail: NTIS HC A07/MF A01 CSCL 14B

36 LASERS AND MASERS

Includes parametric amplifiers.
For related information see also *76 Solid-State Physics.*

N89-15382*# David Sarnoff Research Center, Princeton, NJ.
OPTICAL BACKPLANE INTERCONNECT TECHNOLOGY (OBIT) Contractor Report, 24 Aug. 1987 - 23 Mar. 1988
J. M. Hammer Dec. 1988 38 p
(Contract NAS1-18226)
(NASA-CR-4209; NAS 1.26:4209) Avail: NTIS HC A03/MF A01 CSCL 20E

We describe and analyze a novel approach to implementing an Optical Backplane Interconnect Technology (OBIT) that is capable of optically connecting any row of a 32x32 backplane array to any row of a second 32x32 array. Each backplane array is formed monolithically on a wafer. The technology is based on the use of Grating Surface Emitting (GSE) waveguides formed on a wafer containing quantum-well and separate confinement waveguide layers. These layers are used for transverse guiding, gain, modulation, detection, and for the formation of wavelength tunable distributed-Bragg reflector lasers. The required surface structures are formed photolithographically. The GSE waveguides act as efficient antennae that radiate light at angles selected by tuning the wavelength of the lasers. The same waveguides may be used as the receiving antennae when the array is used in the receiving mode. Thus, wavelength tuning is used to direct each row of the transmitting array to the desired row of the receiving array. In summary: The optical backplane array will have the following characteristics: Any row of a 32x32 GSE array may be optically connected to any row of a second 32x32 array. Only one switch decision is required to switch 32 parallel connections to any one of 32 positions. Each monolithic array can be used as both transmitter and receiver by switching the bias on the quantum-well switch-detectors. Separate transmitting and receiving structures could be provided for duplex operation. For a bit error rate of 10 sup 9 at 100-MHz data rate, a required laser power of 12 mW is calculated based on an estimated total optical loss of 40 dB. Author

N89-15383# Systems Research Labs., Inc., Dayton, OH.
SURFACE THERMOMETRY OF ENERGETIC MATERIALS BY LASER-INDUCED FLUORESCENCE Annual Technical Report, 17 Feb. 1987 - 17 Feb. 1988
Larry P. Goss and Michael E. Post 1 Apr. 1988 36 p Original contains color illustrations
(Contract F49620-87-C-0040)
(AD-A198094; SRL-5510; AFOSR-88-0765TR) Avail: NTIS HC A03/MF A01 CSCL 20M

The laser-induced fluorescence from Dysprosium:YAG has been employed for the measurement of temperature on reacting and nonreacting surfaces. Point, line, and two-dimensional mapping of the surface temperature has been demonstrated utilizing the tripled output (355 nm) of a Neodymium:YAG laser. The temporal and spatial distribution of the temperature was recorded with a two-dimensional intensified imaging system. The technique has also been utilized for the measurement of the thermal depth profile of a plastic material undergoing rapid heating by a carbon dioxide laser. Work is in progress on all three tasks of this program, with the most significant accomplishment of the first year being the demonstration of the two-dimensional thermal imaging of heated inert surfaces. Thermal depth profiling has been conducted with a linear array, while the development of a fiber-optic thermal probe is in progress. Preliminary efforts on bonding techniques of the Dy:YAG crystals were initiated, with plasma spray holding the most promise for nonmetallics. Future efforts on the project will be directed toward two-dimensional measurements on energetic materials, completion of thermal-probe development and applications, and identification of optimum bonding methods for nonmetallic materials. GRA

N89-15384# Loughborough Univ. of Technology (England).
NANOSECOND LASER PHOTOLYSIS OF OPAQUE HETEROGENEOUS PHOTOSENSITIZERS Final Report, 1 May 1985 - 30 Apr. 1988
F. Wilkinson 1 Jul. 1988 179 p
(Contract DAJA45-85-C-0010; DA Proj. 1L1-61102-BH-57)
(AD-A198191; R/D-4409-CH-01) Avail: NTIS HC A09/MF A01 CSCL 07C

The new technique of diffuse reflectance laser flash photolysis has been used to study the photochemistry of molecules, such as acridine and diphenylpolyenes adsorbed on metal oxide surfaces and electronic energy transfer between benzophenone and methylnaphtalene at interfaces. Triplet-triplet absorption spectra and decay kinetics have been observed from aromatic ketones such as xanthone, butyrophenone and valerophenone included within zeolite channels and from ruthenium (II) tris (2,2' bipyridine) both bound to polymers and within cavities of an ion exchange resin. Photophysical processes within dyed fabrics e.g., aluminum phthalocyanine, eosin and erythrosin on cotton have been investigated directly for the first time. Time resolved spectra following laser excitation of porous doped photoelectrodes e.g., zinc oxide doped with cobalt, have been obtained which show isosbestic points as the transient decays by electron transfer to give back Co2 (+). photochemistry, Interfaces, Surfaces, Kubelka munk theory, Laser flash photolysis, Opaque materials, Photochemistry, Picosecond spectroscopy, Semi conductors, Sensitizers, Silica, Thermal effects, Transient absorption, Transient decay, Triplet states. (MJM) GRA

N89-15385# Midwest Bio-Laser Inst., Chicago, IL.
MIDWEST FREE ELECTRON LASER PROGRAM Annual Report, 1 Mar. 1987 - 15 Jun. 1988
L. J. Cerullo, M. Epstein, M. E. Marhic, W. Z. Rymer, and K. G. Spears 31 Jul. 1988 15 p
(Contract N00014-86-K-0188)
(AD-A198243) Avail: NTIS HC A03/MF A01 CSCL 06G

Subablative effects of pulsed Nd:YAG laser (1064nm) on the transmission of neural impulses in spinal cord dorsal white matter, spinal dorsal roots, and peripheral nerve in anesthetized rat were compared. The results to date indicate that long lasting impairment in both spinal synaptic transmission and small fiber input may be mediated by laser irradiation. Nonlinear crystal mixing techniques have been employed to generate tunable infrared laser radiation in the 5 to 7 micron region with duration of 20 picoseconds. Characterization techniques of laser beams from the infrared to the ultraviolet were established for probing energy absorption and relaxation processes. Molecular studies of laser energy absorption and relaxation with relevance to fundamental studies in medicine and neuroscience were initiated. New methods to probe biological tissue with the FEL by spectroscopic or imaging techniques were developed. New fabrication techniques of the whispering-gallery waveguide have been employed to obtain high quality specimens. Needle-like hollow metallic IR waveguides have been fabricated with lengths up to 30cm. A diffuse optics spectrophotometer has been constructed that measures the optical constants of light scattering layers from 450 to 1350nm. Data analysis based on

the diffusion approximation leads to values of the microscopic optical constants. GRA

N89-15386*# Stanford Univ., CA. Labs. of Physics.
HIGH ENERGY EFFICIENT SOLID STATE LASER SOURCES Final Technical Report, 1 Jun. 1981 - 30 Sep. 1988
Robert L. Byer 20 Dec. 1988 31 p
(Grant NAG1-182)
(NASA-CR-184593; NAS 1.26:184593) Avail: NTIS HC A03/MF A01 CSCL 20E

Recent progress in the development of highly efficient coherent optical sources is reviewed. This work focusses on nonlinear frequency conversion of the highly coherent output of the Non-Planar Ring Laser Oscillators developed earlier in the program, and includes high efficiency second harmonic generation and the operation of optical parametric oscillators for wavelength diversity and tunability. Author

N89-15387# Massachusetts Inst. of Tech., Lexington. Lincoln Lab.
N-PULSE LOGIC PEAK DETECTION FOR LASER RADAR RANGE MEASUREMENT OF DISTRIBUTED RANGE TARGETS
David U. Fluckiger 3 Aug. 1988 31 p
(Contract F19628-85-C-0002)
(AD-A199975; STD-2; ESD-TR-88-172) Avail: NTIS HC A03/MF A01 CSCL 17I

In this report N-pulse detection logic is discussed in the context of high angular resolution laser radar range processing. In the event that a resolved target is obscured by one or more unresolved scatterers such as wires, tree branches, camouflage netting, antennas, and the like, one sees multiple returns in the range I.F. due to the multiple scatterers in the line-of-sight path to the target. A laser radar that peak detects the N largest pulses in the range I.F. utilizes N-pulse peak detection logic. This report contains a discussion of the utility of N-pulse logic and also samples of data of N-pulse returns from trees and wires. A limit is found for the average resolvable distance between two scatterers based on Gaussian pulse shapes but not taking into account noise and target fluctuations (speckle). GRA

N89-15388# Texas Univ., Dallas. Center for Quantum Electronics.
PROOF OF THE FEASIBILITY OF COHERENT AND INCOHERENT SCHEMES FOR PUMPING A GAMMA-RAY LASER Annual Technical Report, 1 Jun. 1987 - 31 May 1988
Carl B. Collins Jun. 1988 190 p
(Contract N00014-86-C-2488)
(AD-A199327; GRL/8705) Avail: NTIS HC A09/MF A01 CSCL 09C

Recent approaches to the problem of the gamma-ray laser have focused upon upconversion techniques in which metastable nuclei are pumped with long wavelength radiation. At the nuclear level the storage of energy can approach tera-Joules (10 to the 12th power J) per liter for thousands of years. However, any plan to use such a resource for a gamma-ray laser poses problems of a broad interdisciplinary nature requiring the fusion of concepts taken from relatively unrelated fields of physics. Our research group has described several means through which this energy might be coupled to the radiation fields with cross sections for stimulated emission that could reach 10 to the minus 17th power sq cm. Such a stimulated release could lead to output powers as great as 3 x 10 to the 21st power Watts/liter. Since 1978 we have pursued an approach for the upconversion of longer wavelength radiation incident upon isomeric nuclear populations that can avoid many of the difficulties encountered with traditional concepts of single photon pumping. GRA

N89-15389# Southwest Sciences, Inc., Santa Fe, NM.
A DIODE LASER SENSOR FOR MEASUREMENT OF HYDROGEN CHLORIDE GAS Final Technical Report, 12 Aug. 1987 - 12 Jan. 1988
Alan C. Stanton and Joel A. Silver 29 Feb. 1988 39 p
(Contract DAAD07-87-C-0036)
(AD-A199518; R88-02) Avail: NTIS HC A03/MF A01 CSCL 07B

In the Phase 1 research, breadboard instrumentation incorporating a standard commercial InGaAsP laser diode laser and an optically stable multiple pass absorption cell was used to measure the HCl spectroscopic parameters needed to calibrate the technique and determine the conditions for optimum sensitivity. The technique of two-tone FM spectroscopy employing high frequency laser modulation was then used for direct assessment of the sensitivity limits in measuring low concentrations of HCl in air. The results were compared with a detailed model of the two-tone FM signal in order to analyze the sensitivity for an optimized system. The results of the Phase 1 experiments establish the feasibility of sensitive detection of hydrogen chloride gas with less than 1 second time response using this technique. A sensitivity of three parts per million HCl in air at 50 torr, with a 0.3-second measurement integration time, was demonstrated. GRA

N89-15390# Naval Research Lab., Washington, DC. Condensed Matter Physics Branch.
X-RAY SPECTROSCOPY OF LASER-PRODUCED L-SERIES LINES Interim Report
P. G. Burkhalter and D. A. Newman (Sachs/Freeman Associates, Inc., Landover, MD.) 31 Aug. 1988 29 p
(AD-A199537; NRL-MR-6286) Avail: NTIS HC A03/MF A01 CSCL 07B

High intensity, frequency-tripled, focused light from a multibeam laser system (OMEGA) was utilized to generate plasma of highly-ionized atoms. This work involves the accurate wavelength measurements of 2p-3d,3s,4d,4s lines in L-series spectra of transition elements. The data were collected with high-resolution X-ray spectrographs. The observed lines were classified based on ab initio, atomic structure calculations using adjusted Slater parameters. The spectral results are presented as isoelectronic sequences of the observed and calculated wavelengths for the Li-, Be-, and B-like stages of ionization from atomic numbers 22 (Ti) through 32 (Ge). GRA

N89-15391# Los Alamos National Lab., NM.
TRANSVERSE RESISTIVE-WALL INSTABILITY OF A BUNCHED ELECTRON BEAM IN A WIGGLER
G. Rangarajan and K. C. D. Chan 1988 4 p Presented at the Linear Accelerator Conference, Williamsburg, VA, 3 Oct. 1988
(Contract W-7405-eng-36)
(DE89-000370; LA-UR-88-3006; CONF-881049-4) Avail: NTIS HC A02/MF A01

The transverse motion of a beam traversing a narrow beam pipe is modified by resistive-wall effects. Depending on the strength of the focusing force from the alternating wiggler field, the effect ranges from a modification of the oscillation to a growth in transverse displacement with the length of pipe. This transverse effect saturates after a number of bunches have passed. The saturated transverse effect depends only on the pipe radius b (it increases as 1/b sup 2), but is independent of the thickness tau and conductivity sigma of the pipe. However, tau and sigma affect the time needed to attain saturation. DOE

N89-15392# Los Alamos National Lab., NM.
PROPAGATION OF HIGH-ENERGY LASER BEAMS THROUGH METALLIC AEROSOLS
A. Zardecki and R. L. Armstrong Aug. 1988 9 p Presented at the CRDEC Scientific Conference on Obscuration and Aerosol Research, Aberdeen, MD, 22 Jun. 1988
(Contract W-7405-eng-36)
(DE89-000391; LA-UR-88-2875; CONF-8806239-2) Avail: NTIS HC A02/MF A01

By combining the results of the hydrodynamic code CON1D and the beam propagation code LASER, we investigate the propagation of high-energy laser beams through vaporizing metallic aerosols in the regime for which the plasma generation becomes important. An effective plasma absorption coefficient allows us to

set up a coupled system of equations describing the system consisting of the beam and vapor. DOE

N89-15393# Lawrence Livermore National Lab., CA.
COMPACT X-RAY LASERS IN THE LABORATORY
William A. Barletta 3 Oct. 1988 15 p Presented at the International Seminar on Nuclear War, Erice, Italy, 19 Aug. 1988
Prepared in cooperation with California Univ., Los Angeles
(Contract W-7405-eng-48)
(DE89-001132; UCRL-99661; CONF-8808101-2) Avail: NTIS HC A03/MF A01

Compact X-ray lasers in the laboratory can be produced with ultrahigh gradient RF linacs based on recent advances in linac technology by an SLAC-LLNL-LBL collaboration and on the development of bright, high current electron sources by BNL and LANL. The GeV electron beams generated with such accelerators can be converted to soft X-rays in the range of 2 to 10 nm by passage through short period, high field strength wigglers. Alternatively, the beam can pump a low density dielectric to produce X-rays via recombination. Such linear light sources can produce trains of picosecond (or shorter) pulses of extremely high spectral brilliance suitable for flash holography of biological specimens in vivo and for studies of fast chemical reactions. DOE

N89-15394# Ecole Nationale Superieure des Telecommunications, Paris (France). Dept. Images.
MODELING A SEMICONDUCTOR LASER BY A TWO LEVEL SYSTEM. STUDY OF THE FIRST OPTICAL INSTABILITIES Ph.D. Thesis [MODELISATION D'UN LASER A SEMICONDUCTEUR PAR UN SYSTEME A DEUX NIVEAUX. ETUDE DES PREMIERES INSTABILITES OPTIQUES]
Bruno Thedrez Jun. 1988 232 p In FRENCH
(ENST-88E009; ISSN-0751-1353; ETN-89-93627) Avail: NTIS HC A11/MF A01

The optical polarization in a semiconductor laser is studied using the density matrix formalism. The equivalence with the polarization of a set of two level systems is deduced. The constants of the systems are expressed in terms of the microscopic parameters of the semiconductor (such as gap energy and electron and hole masses). The existence of resonances is demonstrated using a mix of four waves. The resonances are studied as relaxation frequencies. The emergence of double wavelengths is determined in the frequency domain from nonlinear polarization. The results allow to consider the application of the method to study doubling wavelength in other two level systems. ESA

N89-15395*# Stanford Univ., CA. Labs. of Physics.
FREQUENCY STABILIZATION OF DIODE-LASER-PUMPED SOLID STATE LASERS Final Technical Report
Robert L. Byer 12 Dec. 1988 92 p
(Grant NAG1-828)
(NASA-CR-184660; NAS 1.26:184660) Avail: NTIS HC A05/MF A01 CSCL 20E

The goal of the NASA Sunlite program is to fly two diode-laser-pumped solid-state lasers on the space shuttle and while doing so to perform a measurement of their frequency stability and temporal coherence. These measurements will be made by combining the outputs of the two lasers on an optical radiation detector and spectrally analyzing the beat note. Diode-laser-pumped solid-state lasers have several characteristics that will make them useful in space borne experiments. First, this laser has high electrical efficiency. Second, it is of a technology that enables scaling to higher powers in the future. Third, the laser can be made extremely reliable, which is crucial for many space based applications. Fourth, they are frequency and amplitude stable and have high temporal coherence. Diode-laser-pumped solid-state lasers are inherently efficient. Recent results have shown 59 percent slope efficiency for a diode-laser-pumped solid-state laser. As for reliability, the laser proposed should be capable of continuous operation. This is possible because the diode lasers can be remote from the solid state gain medium by coupling through optical fibers. Diode lasers are constructed with optical detectors for monitoring their output power built into their mounting case. A computer can actively monitor the output of each diode laser. If it sees any variation in the output power that might indicate a problem, the computer can turn off that diode laser and turn on a backup diode laser. As for stability requirements, it is now generally believed that any laser can be stabilized if the laser has a frequency actuator capable of tuning the laser frequency as far as it is likely to drift in a measurement time. Author

37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

N89-15396 Massachusetts Univ., Amherst.
TOWARDS COSMOPOLITAN ROBOTS: INTELLIGENT NAVIGATION IN EXTENDED MAN-MADE ENVIRONMENTS Ph.D. Thesis
Ronald Craig Arkin 1987 385 p
Avail: Univ. Microfilms Order No. DA8805889

In the past, mobile robots have been constrained to operate in either an indoor or an outdoor environment, not both. This dissertation leads toward the development of a more cosmopolitan robot; one whose domain of interaction is not as restricted as previous ones. The Autonomous Robot Architecture (AuRA) was developed to meet these challenges. A meadow map, used for global path planning and containing embedded a priori knowledge to guide sensor expectations, serves as the robot's long term memory. A layered short term memory based on instantiated meadows represents the currently perceived world. A hierarchical path planner produces a global path free of collisions with all modeled obstacles. Schema theory is extended to include the mobile robot domain and serves as the principal theoretical framework. The schema-based path execution system handles unexpected and dynamic obstacles not present in the robot's world model. This motor schema-based navigation system produces reactive/reflective behavior in direct response to sensor events. In addition, new techniques in the treatment of robot uncertainty which expedite sensory processing are presented. Included is the use of a spatial error map with associated error growth and reduction. Dissert. Abstr.

N89-15397# National Bureau of Standards, Boulder, CO.
COMPUTERIZATION OF WELDING INFORMATION: A WORKSHOP REPORT
T. A. Siewert and J. E. Jones (American Welding Inst., Louisville, TN.) Jun. 1988 40 p Workshop held in Knoxville, TN, 5-6 Aug. 1986 Sponsored by Naval Ship Research and Development Center, Annapolis, MD
(PB88-236807; NBS-SP-742; LC-88-600543) Avail: NTIS HC A03/MF A01; also available SOD HC $2.00 as 003-003-02876-2 CSCL 13I

Forty-two welding engineers, welding managers, and computer scientists gathered to discuss data bases for welding information. Group discussions identified the most useful topics for welding data bases; general welding procedures; properties of the weld, heat-affected zone, and base metals; procedure qualification records; and welding variables. Characteristics of the data bases were discussed in terms of potential users, content, and sources of information. The participants concluded that a significant portion of the data needs can be met by existing information, but this information should be carefully screened and reviewed before inclusion in data bases. Data bases should be accessible to a diverse group of potential users, and data bases should use the latest computer technology and be upgradable to new technology as it becomes available. GRA

N89-15398*# Maryland Univ., College Park. Dept. of Mechanical Engineering.
SYSTEM CHARACTERIZATION OF A MAGNETICALLY SUSPENDED FLYWHEEL Progress Report, Feb. - Oct. 1988
James A. Kirk, Dave K. Anand, and David P. Plant 17 Nov. 1988 21 p

(Grant NAG5-396)
(NASA-CR-183397; NAS 1.26:183397) Avail: NTIS HC A03/MF A01 CSCL 13I

The purpose of flywheel energy storage is to provide a means to save energy during times when the satellite is in sunlight, and then return the energy during the time when the satellite is in darkness. Typically, an energy storage device operates cyclically, where for satellites in Low Earth Orbit (LEO) the typical period is 60 minutes of sunlight followed by 30 minutes of darkness. If a lifetime of 17 years is required the energy storage system must be capable of sustaining approximately 100,000 cycles. The recent developments at the University of Maryland and how these progressions apply to a 500 Watt-hour magnetically suspended flywheel stack energy storage system are covered. The work includes hardware testing results from a stack flywheel energy storage system, improvements in the area of non-contacting displacement transducers, and performance enhancements of magnetic bearings. The experimental results show that a stack flywheel energy storage system is a feasible technology. Author

N89-15399# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
ANALYSIS AND CONTROL OF ROBOT MANIPULATORS WITH KINEMATIC REDUNDANCY Ph.D. Thesis
Pyung H. Chang Feb. 1988 133 p
(Contracts N00014-80-C-0505; N00014-86-K-0685)
(AD-A198232; AI-TR-1022) Avail: NTIS HC A07/MF A01 CSCL 12I

A closed-form solution formula for the kinematic control of manipulators with redundancy is derived, using the Lagrangian multiplier method. Differential relationships equivalent to the Resolved Motion Method has been also derived. The proposed method is proved to provide with the exact equilibrium state for the Resolved Motion Method. This exactness in the proposed method fixes the repeatability problem in the Resolved Motion Method, and establishes a fixed transformation from workspace to the joint space. Also the method, owing to the exactness, is demonstrated to give more accurate trajectories than the Resolved Motion Method. In addition, a new performance measure for redundancy control has been developed. This measure, if used with kinematic control methods, helps achieve dexterous movements including singularity avoidance. Compared to other measures such as the manipulability measure and the condition number, this measure tends to give superior performances in terms of preserving the repeatability property and providing with smoother joint velocity trajectories. Using the fixed transformation property, Taylor's Bounded Deviation Paths Algorithm has been extended to the redundant manipulators. GRA

N89-15400# Oak Ridge National Lab., TN. Center for Engineering Systems Advanced Research.
SELF-MOTION DETERMINATION BASED ON JOINT VELOCITY BOUNDS FOR REDUNDANT ROBOTS
J. A. Euler, R. V. Dubey (Tennessee Univ., Knoxville.), and S. M. Babcock 1988 10 p Presented at the 2nd International Symposium on Robotics and Manufacturing Research, Education and Applications, Albuquerque, NM, 16 Nov. 1988
(Contract DE-AC05-84OR-21400)
(DE88-012488; CONF-881140-3) Avail: NTIS HC A02/MF A01

The movement of redundant robot joints that does not cause any end-effector motion is referred to as self-motion. Control schemes for redundant robots utilize self-motion to optimize a performance criterion. Thus, commanded joint motion at each sampling step is the sum of the minimum joint motion required for the desired end-effector motion and the self-motion. However, the amount of self-motion is limited by the bounds on joint velocities. A scheme is presented to determine the magnitude of self-motion, the direction of which is determined by a gradient projection scheme. Implementation of this scheme on a Motorola 68020 VME bus-based controller of the seven-degree-of-freedom manipulator at the ORNL Center for Engineering Systems Advanced Research (CESAR) is described. DOE

N89-15401# Sandia National Labs., Albuquerque, NM.
THE ROLE OF MODEL BASED CONTROL IN ROBOTICS
R. W. Harrigan 1988 13 p Presented at the 2nd International Symposium on Robotics and Manufacturing Research, Education and Applications, Albuquerque, NM, 16 Nov. 1988
(Contract DE-AC04-76DP-00789)
(DE88-012857; SAND-88-1878C; CONF-881140-1) Avail: NTIS HC A03

This paper discusses the use of model based control of industrial robots to achieve automatic programming of robot trajectories, hybrid force/position control and computer assisted manual operation. Experiments at Sandia National Laboratories are reviewed to illustrate the impact of model based control on the operation of robotic systems. Computer models of the robots and their operating environments are complemented with environmental sensing. Sensing allows, for example, correlation of modeled geometries with the location of objects in the actual environment. In addition, sensors detect error situations which may require operator attention prior to continued system operation. Computer models are used to verify the validity of sensor data before the robotic system executes operations based upon those data. DOE

N89-15402# Oak Ridge National Lab., TN. Center for Engineering Systems Advanced Research.
NAVIGATION AND LEARNING EXPERIMENTS BY AN AUTONOMOUS ROBOT
G. deSaussure, C. R. Weisbin, and P. F. Spelt 1988 15 p Presented at the 2nd International Symposium on Robotics and Manufacturing Research, Education and Applications, Albuquerque, NM, 16 Nov. 1988
(Contract DE-AC05-84OR-21400)
(DE88-014546; CONF-881140-5) Avail: NTIS HC A03/MF A01

Developing an autonomous mobile robot capable of navigation, surveillance and manipulation in complex and dynamic environments is a key research activity at CESAR, Oak Ridge National Laboratory's Center for Engineering Systems Advanced Research. The latest series of completed experiments was performed using the autonomous mobile robot HERMIES-IIB (Hostile Environment Robotic Machine Intelligence Experiment Series II-B). The next section describes HERMIES-IIB and some of its major components required for autonomous operation in unstructured, dynamic environments. Section 3 outlines some ongoing research in autonomous navigation. Section 4 discusses our newest research in machine learning concepts. Section 5 describes a successful experiment in which the robot is placed in an arbitrary initial location without any prior specification of the content of its environment, successively discovers and navigates around stationary or moving obstacles, picks up and moves small obstacles, searches for a control panel and performs a learned sequence of manipulations on the panel devices. The last section outlines some future directions of the program. DOE

N89-15403# Oak Ridge National Lab., TN. Instrumentation and Controls Div.
TELEROBOTIC VEHICLE FOR EVALUATING REMOTE BATTLEFIELD SUPPORT OPERATIONS
B. S. Richardson, G. A. Armstrong, and W. W. Manges 1988 11 p Presented at the 2nd International Symposium on Robotics and Manufacturing Research, Education and Applications, Albuquerque, NM, 16 Nov. 1988
(Contract DE-AC05-84OR-21400)
(DE88-014559; CONF-881140-4) Avail: NTIS HC A03/MF A01

A general purpose mobile telerobotic testbed is being developed for studying and evaluating the application of telerobotic technology in battlefield support operations. The system provides teleoperation capability to address the functional feasibility of mobile telerobotics technology with an emphasis on soldier machine interface issues. DOE

N89-15404# Oak Ridge National Lab., TN.
TESTING OF A STIRLING CYCLE COOLER
F. C. Chen, E. G. Keshock (Tennessee Univ., Knoxville.), and R.

W. Murphy Sep. 1988 15 p Presented at the ASME Winter Annual Meeting, Chicago, IL, 28 Nov. 1988
(Contract DE-AC05-84OR-21400)
(DE88-017362; CONF-881120-9) Avail: NTIS HC A03/MF A01

Stirling cycle coolers have long been used as low temperature refrigeration devices. They are relatively compact, reliable, commercially available, and use helium as the working fluid. The Stirling cycle, in principle, can be used for household refrigeration and heat pumping applications as well. Currently, these applications are almost entirely provided by the vapor compression technology using chlorofluorocarbons (CFCs) as working fluids. It has been known that CFCs cause depletion of the ozone layer that protects the earth against harmful levels of ultraviolet radiation from the sun. A recent report of a hole in the ozone layer above Antarctica and of possible environmental and health consequences from ozone depletion aroused public attention. The urgent need to reduce the future used of CFCs should instigate investigation of non-CFC alternative technologies. The Stirling cooler technology, which does not use CFCs, could be a viable alternative. A laboratory test of the performance of a Stirling cooler is reported and its implications for household refrigeration are explored. DOE

N89-15405# Oak Ridge National Lab., TN. Center for Engineering Systems Advanced Research.
RECENT CESAR (CENTER FOR ENGINEERING SYSTEMS ADVANCED RESEARCH) RESEARCH ACTIVITIES IN SENSOR BASED REASONING FOR AUTONOMOUS MACHINES
F. G. Pin, G. deSaussure, P. F. Spelt, S. M. Killough, and C. R. Weisbin 1988 6 p Presented at the International Workshop on Intelligent Robots and Systems, Tokyo, Japan, 31 Oct. 1988
(Contract DE-AC05-84OR-21400)
(DE88-017364; CONF-8810168-1) Avail: NTIS HC A02

This paper describes recent research activities at the Center for Engineering Systems Advanced Research (CESAR) in the area of sensor based reasoning, with emphasis being given to their application and implementation on our HERMIES-IIB autonomous mobile vehicle. These activities, including navigation and exploration in a-priori unknown and dynamic environments, goal recognition, vision-guided manipulation and sensor-driven machine learning, are discussed within the framework of a scenario in which an autonomous robot is asked to navigate through an unknown dynamic environment, explore, find and dock at the panel, read and understand the status of the panel's meters and dials, learn the functioning of a process control panel, and successfully manipulate the control devices of the panel to solve a maintenance emergency problems. A demonstration of the successful implementation of the algorithms on our HERMIES-IIB autonomous robot for resolution of this scenario is presented. Conclusions are drawn concerning the applicability of the methodologies to more general classes of problems and implications for future work on sensor-driven reasoning for autonomous robots are discussed. DOE

N89-15406# Sandia National Labs., Albuquerque, NM. Process Metalurgy Div.
CONSEQUENCES OF Nd:YAG LASER WELDING Al-Mg AND Al-Mg-Si ALLOYS
M. J. Cieslak and P. W. Fuerschbach 1988 6 p Presented at the JOWOG 22nd Joining Subgroup, Aldermasten, England, 4 Oct. 1988
(Contract DE-AC04-76DP-00789)
(DE89-001047; SAND-88-0935C; CONF-8810176-3) Avail: NTIS HC A02/MF A01

Aluminum alloys 6061, 5456, and 5086 were fusion welded with both pulsed and continuous wave Nd:YAG laser processing. Continuous welds were made with a Holobeam 6-head, 600 watt laser operated at full power (approx. 675 watts). The pulsed welds were made with a Raytheon SS-501-7,400 watt laser operated at 180 watts average power. The experimental details have been reported previously. The purpose of the work was to characterize the effect of Nd:YAG laser welding on the soundness (hot-cracking susceptibility), fusion zone chemistry modification by preferential vaporization of volatile elements, and mechanical response (hardness) of these alloys. DOE

N89-15407# Sandia National Labs., Albuquerque, NM. Materials and Process Sciences Directorate.
PULSED Nd:YAG LASER WELDING OF TITANIUM ALUMINIDE
M. J. Cieslak and T. J. Headley 1988 5 p Presented at the JOWOG 22D Joining Subgroup, Aldermasten, United Kingdom, 4 Oct. 1988
(Contract DE-AC04-76DP-00789)
(DE89-001048; SAND-88-0937C; CONF-8810176-2) Avail: NTIS HC A02/MF A01

Titanium aluminides are an interesting new class of intermetallic alloys having useful strength-to-weight ratios for a variety of military and aerospace applications. In particular, the alloys based upon the ordered hexagonal (alpha sub 2, DO sub 19) compound, Ti sub 3 Al, are finding applications in some present aerospace designs. In the present study we examine the response of the Ti sub 3 Al derivative ternary alloy Ti-24Al-11Nb (at. percent) to pulsed Nd:YAG laser welding from the perspective of bend ductilities and evolution of microstructure. This alloy was processed as 1.7 mm thick sheet having a microstructure of matrix alpha sub 2 (approx. 95 percent) and intergranular beta (body-centered-cubic). A Raytheon SS-501-7 pulsed Nd:YAG laser welding system was used. Samples were predominantly bead-on-plate welds made in an argon atmosphere (less than 0.1 ppM O sub 2) glovebox at 200 watts average power with a 10 Hz pulse frequency. Greater experimental detail has been reported previously. DOE

N89-15408# Argonne National Lab., IL. Materials and Components Technology Div.
HIGH TEMPERATURE FRICTION AND WEAR CHARACTERISTICS OF SUPERALLOYS X-750 AND 188 FOR USE IN LOW HEAT REJECTION ENGINES
A. Erdemir and G. R. Fenske 1988 27 p Presented at the Metallurgical Society Fall Meeting and American Society for Metals Materials Week, Chicago, IL, 24 Sep. 1988
(Contract W-31-109-eng-38)
(DE89-000620; CONF-880901-4) Avail: NTIS HC A03/MF A01

Engineering materials for use in low heat rejection engines are required to function under stringent tribological conditions. Severe wear damage and high friction between the components of the tribosystem limit the number of potential materials suitable for such application conditions. The superalloys X-750 and 188 are composed of alloying elements that not only promote a high mechanical and chemical stability but may also result in a reduced wear rate and friction coefficient at elevated temperatures. The present study was undertaken to evaluate the tribological characteristics of these alloys that will also be utilized as the substrates for ion beam deposited lubricous coatings. A wear test rig that crudely simulated the sliding conditions between a piston ring and a cylinder liner in an operating engine was utilized for friction and wear studies. The test results indicated that the wear and friction properties of these alloys were very sensitive to the test temperature. At lower temperatures, the friction coefficients and the wear rates were high. Whereas, at high temperatures (i.e., 600 C), the coefficients of friction and the wear rates were relatively low and the oxidation of rubbing surfaces was rather severe. DOE

N89-15409# Royal Signals and Radar Establishment, Malvern (England).
ASSESSMENT OF THE PHILIPS USFA BV 7 mm COOLING ENGINE
D. P. Laycock and W. J. A. Powell May 1988 45 p
(RSRE-MEMO-87018; BR107337; ETN-89-93669) Copyright Avail: NTIS HC A03/MF A01

Stirling cycle split-mode cooling engines, sampled from development, preproduction, and production batches, were tested. Cryogenic performance at normal and high ambient temperatures in run-stop-run and continual-run regimes was measured. Detector encapsulations were interfaced to provide typical combination heat loads. One preproduction unit was installed and operated

successfully in a thermal imaging common module class 2 scanner. Detector microphony-noise measurements were compared with those recorded when the same array was cooled with high pressure pure gas liquified by a self-regulating minicooler. Initial problems of contamination of the helium gas and of the thermal interface with the detector encapsulation were addressed. A production standard unit achieved over 5000 hr intermittent and continuous running during 12 months. ESA

N89-15410# National Aerospace Lab., Amsterdam (Netherlands). Space Div.
FLEXIBLE ROBOTIC MANIPULATOR IN SPACE: TOWARDS A MATHEMATICAL DYNAMICS TRUTH MODEL
P. Th. L. M. vanWoerkom 15 Sep. 1987 49 p
(Contract NIVR-02506-N)
(NLR-TR-87129-U; ETN-89-93889) Avail: NTIS HC A03/MF A01

A mathematical truth model for the dynamics of a robotic manipulator which is attached to an orbiting spacecraft-manipulator system consisting of structurally flexible bodies is discussed. The dynamics equations for a single constituent body in the spacecraft-manipulator system are developed, using the method of hybrid coordinate modeling. The equations obtained are to form the basis for the development of the dynamics equations of the entire spacecraft manipulator system. ESA

N89-15411 Stanford Univ., CA.
KINEMATIC ANALYSIS AND DESIGN OF REDUNDANT ROBOT MANIPULATORS Ph.D. Thesis
Joel Wakeman Burdick 1988 268 p
Avail: Univ. Microfilms Order No. DA8814984

A class of robots known as redundant manipulators are investigated. A redundant manipulator is one that has more degrees of freedom than is generally accepted as the minimum number required to perform nominally useful tasks. Redundancy can be useful in the design and control of robot systems. A combination of geometric and topological tools are used to investigate the kinematic aspect of redundancy. The emphasis is on developing a framework for global kinematic analysis that is a reformulation of manipulator kinematics as a global manifold mapping problem. The singularities of the forward kinematic separate the configuration space manifold into disjoint regions. The number, geometry, and topology of these regions and their forward mappings can be used to rigorously determine a variety of kinematic properties, such as the maximum number of inverse kinematic solutions and manipulator behavior during cyclic motions, for manipulators of arbitrary geometry and number of degrees of freedom. An attempt was made to unify the analysis for both nonredundant and redundant manipulators. Dissert. Abstr.

N89-15412 Texas A&M Univ., College Station.
ANALYSIS OF ECCENTRIC ANNULAR PRESSURE SEALS: A NEW SOLUTION PROCEDURE FOR DETERMINING REACTIVE FORCE AND ROTOR-DYNAMIC COEFFICIENTS Ph.D. Thesis
Dung Thanh Nguyen 1988 146 p
Avail: Univ. Microfilms Order No. DA8815906

A new analysis procedure which solves for leakage, reactive force, and rotordynamic coefficients of eccentric annular fluid and gas pressure seals is presented. This analysis procedure is based on a perturbation technique and utilizes a turbulent bulk-flow model with Moody's friction factor. A set of zeroth-order equations and a set of first-order equations are derived from a perturbation of the flow variables. Solution to the zeroth-order equations yields leakage and ractive force; whereas solution to the first-order equations yields the rotordynamic coefficients. The solution for the zeroth-order equations is obtained by means of a new and efficient integration technique. Comparisons with existing experimental data indicate that predictions for liquid annular seals are very good. However, predictions for annular gas seals cannot be verified due to lack of test data. The results of this study also indicate that in systems of relatively low rotor stiffness, a rotor eccentricity below 0.40 in annular seals has essentially no effect on the vibration characteristics of the rotor. Dissert. Abstr.

N89-15413*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
DYNAMIC LOADING OF SPUR GEARS WITH LINEAR OR PARABOLIC TOOTH PROFILE MODIFICATION
Hsiang Hsi Lin (Memphis State Univ., TN.), Fred B. Oswald, and Dennis P. Townsend [1989] 19 p Prepared for presentation at the 5th International Power Transmission and Gearing Conference, Chicago, IL, 25-27 Apr. 1989; sponsored by ASME Sponsored in part by Army
(DA Proj. 1L1-62209-AH-76)
(NASA-TM-101444; E-4225; NAS 1.15:101444;
AVSCOM-TR-88-C-003) Avail: NTIS HC A03/MF A01 CSCL 13I

A computer simulation was conducted to investigate the effects of both linear and parabolic tooth profile modification on the dynamic response of low-contact-ratio spur gears. The effect of the total amount of modification and the length of the modification zone were studied at various loads and speeds to find the optimal profile modification for minimal dynamic loading. Design charts consisting of normalized maximum dynamic load curves were generated for gear systems operated at various loads and with different tooth profile modification. An optimum profile modification can be determined from these design charts to minimize the dynamic loads of spur gear systems. Author

N89-15414*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
WEAR CONSIDERATION IN GEAR DESIGN FOR SPACE APPLICATIONS
Lee S. Akin (California State Univ., Long Beach.) and Dennis P. Townsend [1989] 8 p Prepared for presentation at the 5th International Power Transmission and Gearing Conference, Chicao, IL, 25-27 Apr. 1989; sponsored by ASME
(Grant NAG3-20; DA Proj. 1L1-62209-A-47-A)
(NASA-TM-101457; E-4532; NAS 1.15:101457;
AVSCOM-TR-88-C-033) Avail: NTIS HC A02/MF A01 CSCL 13I

A procedure is described that was developed for evaluating the wear in a set of gears in mesh under high load and low rotational speed. The method can be used for any low-speed gear application, with nearly negligible oil film thickness, and is especially useful in space stepping mechanism applications where determination of pointing error due to wear is important, such as in long life sensor antenna drives. A method is developed for total wear depth at the ends of the line of action using a very simple formula with the slide to roll ratio V sub s/V sub r. A method is also developed that uses the wear results to calculate the transmission error also known as pointing error of a gear mesh. Author

N89-15415*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
LUBRICANT JET FLOW PHENOMENA IN SPUR AND HELICAL GEARS WITH MODIFIED ADDENDUMS; FOR RADIALLY DIRECTED INDIVIDUAL JETS
Lee S. Akin (California State Univ., Long Beach.) and Dennis P. Townsend [1989] 13 p Prepared for presentation at the 5th International Power Transmission and Gearing Conference, Chicago, IL, 25-27 Apr. 1989; sponsored by ASME
(Grant NAG3-20; DA Proj. 1L1-62209-A-47-A)
(NASA-TM-101460; E-4533; NAS 1.15:101460;
AVSCOM-TR-88-C-034) Avail: NTIS HC A03/MF A01 CSCL 13I

This paper develops the mathematical relations for the Virtual Kinetic Model as an improvement over the vectorial model developed earlier. The model solution described provides the most energy efficient means of cooling gears, i.e., it requires the least pressure or pumping power to distribute the coolant onto the tooth surface. Further, this nozzle orientation allows impingement to the root of the tooth if needed and provides the most cooling control when compared to into-mesh and out-of-mesh cooling. Author

N89-15582*# Tennessee Univ., Knoxville. Dept. of Electrical and Computer Engineering.
AUTOMATIC INSPECTION OF ANALOG AND DIGITAL METERS IN A ROBOT VISION SYSTEM
Mohan M. Trivedi, Suresh Marapane, and ChuXin Chen *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 233-242 (For primary document see N89-15549 07-61)
(Contract DE-FG02-86NE-31968)
Avail: NTIS HC A21/MF A01 CSCL 13I

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N89-15416# Pratt and Whitney Aircraft, West Palm Beach, FL.
RELIABILITY, MAINTAINABILITY, AND SAFETY: BIBLIOGRAPHY
7 Apr. 1988 58 p
Avail: NTIS HC A04/MF A01 CSCL 14D
This bibliography includes information given at AIAA SESTC technical meetings since 1982. B.G.

N89-15417# Louisiana State Univ., Baton Rouge. Dept. of Electrical and Computer Engineering.
NON-DESTRUCTIVE TESTING USING INFRARED BIREFRINGENCE Final Report, 6 Aug. 1984 - 5 Feb. 1988
Aloke K. Dutta, Pratul K. Ajmera, and Burke Huner 20 Jul. 1988 63 p
(Contract DAAG29-84-K-0153)
(AD-A198141; ARO-21261.2-MS) Avail: NTIS HC A04/MF A01 CSCL 14B
In this work, the technique of infrared piezo birefringence is investigated for characterization of defects in semiconductor materials. As a first step towards simulating defect images, the cases of diametrically loaded discs of Si and GaAs were examined. Simulated images were generated by a computer and were compared with the experimentally obtained ones subjected to the same conditions. The results showed an excellent match between the two cases. The behavior of the stress-optic coefficient C was also investigated in this work. The value of C has been taken to be a constant in earlier works by other investigators. GRA

N89-15418# Massachusetts Inst. of Tech., Cambridge.
APPROXIMATE EVALUATION OF RELIABILITY AND AVAILABILITY VIA PERTURBATION ANALYSIS Final Report, Jun. 1984 - Sep. 1987
Bruce K. Walker, Sin-Kwong Chu, and Norman M. Wereley Mar. 1988 131 p
(Grant AF-AFOSR-0160-84; AF Proj. 2304)
(AD-A199940; AFOSR-88-0975TR) Avail: NTIS HC A07/MF A01 CSCL 12G
The progress on a three-year effort to examine approximate reliability evaluation techniques for fault tolerant control and sensor systems is described. The motivation for the work is provided by the fact that the reliability models for these systems tend to be finite state semi-Markov models with large dimension that evolve relatively slowly in time due to the rare occurrence rate of component failures. The transient behavior of these models is of interest because the steady state behavior is trivial and not of practical importance. The evaluation of the transient behavior of such models, however, is intractable even for relatively simple system architectures because of the widely varying rates at which events occur in the model. The research effort concentrates on generating useful limit theorems that approximate the behavior of these models asymptotically. Using the work of Korolyuk as a starting point, limit theorems are generated for both continuous and discrete time models that are representative of fault tolerant system behavior. In particular, the limit theorems of Korolyuk are expanded to cover models where the classes of the decomposed models include trapping states when the small parameter vanishes and to cover models where the holding times are not necessarily scaled by the small parameter. GRA

N89-15419# Instituut TNO voor Werktuigkundige Constructies, Delft (Netherlands).
EXPLORATORY INVESTIGATION OF THE ACTIVITIES IN THE FIELD OF RELIABILITY AND MAINTAINABILITY IN THE NETHERLANDS [EEN VERKENNEND ONDERZOEK NAAR DE ACTIVITEITEN OP RELIABILITY AND MAINTAINABILITY-GEBIED IN NEDERLAND]
H. Knoll Dec. 1986 69 p In DUTCH
(Contract A86/KM/134)
(IWECO-5076702-86-1; TD-87-3634; ETN-89-93445) Avail: NTIS HC A04/MF A01
Reliability and maintainability (R and M) engineering activities in Dutch companies were explored, mainly via interviews. The procedure of the investigation and its limitations are presented. The reasons which motivate the companies to apply R and M techniques or not to use them are depicted. The applied techniques are surveyed according to industry and product types. ESA

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.
For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

N89-15420 Johns Hopkins Univ., Baltimore, MD.
SHELL FINITE ELEMENT KINEMATICS FOR IMPROVED BENDING, MEMBRANE AND TRANSVERSE SHEAR BEHAVIOR Ph.D. Thesis
Edhi Sutjahjo 1987 149 p
Avail: Univ. Microfilms Order No. DA8807476
A displacement-based finite element formulation is developed for the approximate stress analysis of shells. The formulation is derived following the kinematics of the Love-Mindlin-Novozhilov theory for shells. This allows the analysis of thin to moderately thick shells considering bending, membrane, and tranverse shear deformation. Attention is directed to shells made of homogeneous, isotropic, and linearly elastic materials. The extension to orthotropic and nonlinear materials is direct. Bending deformation is formulated to be kinematically independent from membrane and transverse shear deformation. This is accomplished by constructing an inextensional thin shell bending solution, referred to as the integrated bending field. Integrability constraints are imposed on the element to ensure kinematic capatibility in an integra sense. The constraints are formulated separately for plates, single-curvature shells, and double-curvature shells. The proposed integrated bending field is derived using the isoparametric interpolation basis. The interpolated deflection and rotation fields are explicitly defined in the element, and local normals are constructed on the mid-surface to define the thickness direction. Full integration of the stiffness matrix is utilized, hence no spurious kinematic modes are produced. Numerical results show the good accuracy, reliability, and efficiency of this element for modeling bending, membrane, and transverse shear deformation. Comparison with other prevalent formulations shows the advantage of the present method. The extension of this formulation to nonlinear kinematics and layered materials is discussed.
Dissert. Abstr.

N89-15421# General Electric Co., Schenectady, NY. Knools Atomic Power Lab.
A CRACK EXTENSION LIMIT FOR FRACTURE INSTABILITY DATA
B. D. Macdonald Nov. 1987 11 p
(Contract DE-AC12-76SN-00052)
(DE89-000631; KAPL-4197) Avail: NTIS HC A03/MF A01
Fracture instability data, with and without significant stable crack

extension, and J sub IC tearing-onset data were studied to find a crack extension limit for the fracture instability data from low alloy steels. New A508-Class 2 data were used to identify both tearing onset (valid J sub IC) and fracture instability response curves (fracture toughness was well below J sub IC. A fracture instability value of J was considered qualified as a fracture toughness parameter provided that the crack extension at instability was less than or equal to 0.15 mm. Data with greater crack extension were shown to be tearing onset data even if the specimen failed by fracture instability. Thinner-than-standard specimens were found more likely to provide tearing onset data than were standard thickness specimens. DOE

N89-15422# Rockwell International Corp., Thousand Oaks, CA. Science Center.
INTEGRATION OF STATISTICAL AND PHYSICAL MODELS OF SHORT FATIGUE CRACK GROWTH Final Report, 15 Jan. 1985 - 14 Apr. 1988
B. N. Cox and W. L. Morris Jun. 1988 139 p
(Contract F49620-85-C-0034)
(AD-A197917; SC5418.FR; AFOSR-88-0690TR) Avail: NTIS HC A07/MF A01 CSCL 20K

The probabilistic analysis of the propagation of small fatigue cracks has been investigated. Monte Carlo simulations have been formulated that can embrace nearly all details of the micromechanics of small crack growth. They calculate the propagation of the entire, irregular crack front as it passes through a random microstructure. The simulations illuminate both the mechanics and the statistics of small crack growth. A computationally efficient probabilistic model has also been formulated as the basis of lifetime prediction in field application. The probabilistic model is sufficiently flexible to allow incorporation of the physical aspects of propagation that have been shown in the Monte Carlo simulations to be necessary for accurate predictions. In particular, the probabilistic model begins with the premise that two independent variables, for example but not necessarily the crack length and the crack shape, are required to account for the observed statistics of growth. GRA

N89-15423# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
STRUCTURAL DYNAMICS MODEL OF A CARTESIAN ROBOT Ph.D. Thesis
Alfonso G. Reynoso Oct. 1985 221 p
(Contract N00014-85-K-0124)
(AD-A198053; AI-TR-1009) Avail: NTIS HC A10/MF A01

Methods are developed for predicting vibration response characteristics of systems with change configuration during operation. A Cartesian robot, an example of such a position-dependent system, served as a test case for these methods and was studied in detail. The chosen system model was formulated using the technique of Component Mode Synthesis. The mathematical model assumes that the system is slowly varying, and connects the carriages to each other and to the robot structure at the slowly-varying connection points. The modal data required for each component is obtained experimentally in order to get a realistic model. The analysis results in prediction of vibrations that are produced by the inertia forces as well as gravity and friction forces which arise when the robot carriages move with some prescribed motion. Computer simulations and experimental determinations are conducted in order to calculate the vibrations at the robot end-effector. Comparisons are shown to validate the model in two ways: for fixed-configuration the mode shapes and natural frequencies are examined, and then for changing configuration the residual vibration at the end of the move is evaluated. A preliminary study was done on a geometrically nonlinear system which also has position-dependency. GRA

N89-15424# Naval Research Lab., Washington, DC.
THE EFFECT OF FIRST REFLECTIONS IN THE DYNAMIC TEAR TEST
Virginia M. Gensheimer, L. M. Brock (Kentucky Univ., Lexington.), and M. I. Jolles 8 Sep. 1988 25 p
(AD-A199538; NRL-MR-6232) Avail: NTIS HC A03/MF A01 CSCL 20K

The dynamic tear (DT) test is often used to study dynamic fracture. Previous work has indicated that the first impact waves arriving at the specimen notch may not create a stress severe enough for fracture. In this article, a finite element program for the exact dynamic simulation of an actual DT test is first compared with an analytical solution for the time interval prior to reflected wave appearance. The finite element results are then used to study the exact stress field near the specimen notch. This study demonstrated that is is the arrival of the first reflected waves at the notch which generate the stress field necessary for fracture. These results are then used to estimate a critical dynamic stress intensity factor value for the DT test. GRA

N89-15425# Aeronautical Research Labs., Melbourne (Australia).
CRKGRW: CRACK GROWTH PROGRAM USER'S MANUAL
J. Paul and D. Lombardo Jun. 1988 43 p
(AD-A199552; ARL-STRUC-TM-492; DODA-AR-005-532) Avail: NTIS HC A03/MF A01 CSCL 11F

This report is a manual for using CRKGRW Version 2.0 (hereafter called CRKGRW) to calculate crack growth using various models. Relevant background theory is also included. CRKGRW is essentially an upgrading of the FORTRAN 77 program CRKGRW Version 1.0 with program bugs removed and more options added. CRKGRW Version 1.0 is itself a modification of CRACKS IV. This was a FORTRAN IV program written by R. M. Engle, Jr. of the Air Force Flight Dynamics Laboratory, Wright Patterson Air Force Base. The essence of crack growth programs is to calculate the change in crack length resulting from the application of a single load cycle. This is repeated for each load cycle in the sequence resulting in the total crack length and the time to failure being calculated. GRA

N89-15426# Army Cold Regions Research and Engineering Lab., Hanover, NH.
BEHAVIOR OF MATERIALS AT COLD REGIONS TEMPERATURES. PART 1: PROGRAM RATIONALE AND TEST PLAN
Piyush K. Dutta Jul. 1988 73 p
(AD-A199566; CRREL-SR-88-9-Pt-1) Avail: NTIS HC A04/MF A01 CSCL 15E

Newer materials and products are being constantly added to the Army's inventory. Cold regions climatic conditions should not impair the reliability and durability of these new systems. This report discusses the rationale of the test program being undertaken to evaluate material behavior at low temperatures. Cold regions, Compression, Tension testing, Low temperatures, Materials testing. GRA

N89-15427# Sandia National Labs., Albuquerque, NM.
BENDING RESPONSE OF KEVLAR 49/EPOXY BEAMS AND RINGS
E. D. Reedy, Jr. and T. R. Guess 1988 7 p Presented at the JOWOG-28 Meeting, Albuquerque, NM, 1 Oct. 1988
(Contract DE-AC04-76DP-00789)
(DE89-000637; SAND-88-2670C; CONF-8810151-5) Avail: NTIS HC A02/MF A01

Kevlar 49/epoxy laminates often exhibit substantial material nonlinearity when subjected to bending. A unidirectionally reinforced Kevlar 49 lamina is nearly linear elastic to failure in tension, however, in fiber-directed compression, it responds in a perfectly plastic-like manner once a compressive strength of roughly 20 percent of its tensile ultimate strength is exceeded. This combined linear tensile/nonlinear compressive behavior is the source of Kevlar 49/epoxy's flexural nonlinearity. Since Kevlar 49 reinforced laminates can often carry bending loads well above those needed to cause initial compressive yield, it is desirable to be able to predict the post-yield flexural response. In this presentation, analyses that utilize a simple idealization of compressive yielding

are described and calculated results for Kevlar 49 reinforced beams and rings are compared with available data. DOE

N89-15428# Research Inst. of National Defence, Stockholm (Sweden).
DOUBLE CURVED SHELLS: BENDING GEOMETRY, LOAD CARRYING PROPERTIES, AND TECHNICAL APPLICATIONS; AN INTRODUCTORY STUDY
Sture O. Lundin Jun. 1988 48 p In SWEDISH; ENGLISH summary
(FOA-C-20723-2.6; ISSN-0347-3694; ETN-89-93542) Avail: NTIS HC A03/MF A01

Thin shells, primarily of compound curvature were found to have interesting bending and load carrying properties. A preparatory study of these properties is described. It covers principles, mathematics, computation of strength, experiments, potential applications, choice of material, and ideas regarding methods of production. Double curved shells can be made of metal, composite plastic material, or wood. Models tested of glass fiber reinforced plastics, and of thermoplastics show a good agreement with the computed figures. ESA

N89-15429# Research Inst. of National Defence, Stockholm (Sweden).
DOUBLE CURVED SHELLS: BENDING GEOMETRY, LOAD CARRYING PROPERTIES, AND TECHNICAL APPLICATIONS Status Report, 1986-1987
Sture O. Lundin Jun. 1988 29 p In SWEDISH; ENGLISH summary
(FOA-C-20724-2.6; ISSN-0347-3694; ETN-89-93543) Avail: NTIS HC A03/MF A01

Thin shells of compound curvature show properties of being bendable between compact rolled-up configurations and spacious load-carrying conditions. The use of these properties makes it possible to construct elements that are compact for storage and transportation and being voluminous and load-carrying while in use, for example bridges, masts, and space applications. The bending characteristics of actual shells are described, including their mathematical treatment, manufacture of prototypes, aspects of materials, and a summary of potential applications. ESA

N89-15430# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Abteilung Strukturberechnung.
IMPROVED TRANSVERSE SHEAR STIFFNESS FOR LAYERED FINITE ELEMENTS
Klaus Rohwer Aug. 1988 28 p
(DFVLR-FB-88-32; ISSN-0171-1342; ETN-89-93756) Avail: NTIS HC A03/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 13 Deutsche marks

A procedure based on equilibrium conditions for transverse shear stiffness coefficients in finite element methods is proposed. Integrating the equilibrium conditions leads to shear stresses as functions of membrane force and bending moment derivatives, which can be replaced by transverse shear forces if cylindrical bending states are assumed. These functions are used in the complementary energy density to determine improved stiffness. For homogeneous material they correspond with Reissner's correction factor of 5/6 as applied to shear modulus times thickness. Isotropic layers, however, show correction factors between 0.45 and 1.0 depending on the layer thickness and modulus ratios. The proposed formulation covers orthotropic material as well as sandwich constructions. With it, different versions of layered and sandwich elements become obsolete. ESA

N89-15431# National Aerospace Lab., Amsterdam (Netherlands). Space Div.
ACCURACY OF MODAL FREQUENCY SET WITH FICTITIOUS JOINTS MODELING
P. Th. L. M. vanWoerkom 26 May 1987 32 p Sponsored by the Netherlands Agency for Aerospace Programs, Delft
(NLR-TR-87126-U; ETN-89-93887) Avail: NTIS HC A03/MF A01

The accuracy of the fictitious joints modeling technique is assessed relative to the standard distributed parameter modeling technique. The system is a pinned-pinned Euler-Bernouilli beam. The accuracy criterion is the error in the modal frequencies for the two modeling techniques. The accuracy of the fictitious joints model is very good, although it degrades with increasing mode number. Inaccuracies in the modal frequencies may (after system assembly) lead to errors in those modal frequencies that are located within the bandwith of interest of the assembled system. The modal frequencies for the fictitious joints model are always lower than those for the truth model. This is a convenient property when choosing integration step sizes for numerical simulations. ESA

N89-15432 California Univ., Berkeley.
A SELF ADAPTIVE FINITE ELEMENT TECHNIQUE FOR STRUCTURAL DYNAMIC ANALYSIS Ph.D. Thesis
Kuan-Jung Joo 1987 153 p
Avail: Univ. Microfilms Order No. DA8813931

An adaptive finite element discretization technique, which uses derived Ritz vectors, is presented for solving structural dynamic problems. The special Ritz vectors are applied as the bases of transformation in geometric coordinates for mode superposition dynamic analysis. To capture the low and high frequency response using multigrid principles, an hierarchical formulation for forming the coefficient matrices is proposed and it is used in the framework of the adaptive h-refinement. An a posteriori energy norm of static residual error serves as the error measure. To determine the number of Ritz vectors for dynamic analysis, cut off criteria are introduced based on the participation of the spatial distribution of applied loading and the participation of the mass distribution. Assuming that the solution can be resolved into a set of orthogonal vectors and the refined mesh which passes the refinement criteria for all the vectors are applied to discretize the continuous spatial domain. The Ritz vectors are scaled by weighting factors which are dependent on the frequencies of Ritz vectors, and the participation of load and stiffness. The scaled Ritz vectors are then used as the bases to refine the mesh. Dissert. Abstr.

N89-15433*# Catholic Univ. of America, Washington, DC. Dept. of Mechanical Engineering.
ACTIVE CONTROL OF BUCKLING OF FLEXIBLE BEAMS Final Report
A. Baz and L. Tampe 19 Jan. 1989 35 p
(Grant NAG5-520)
(NASA-CR-183333; NAS 1.26:183333) Avail: NTIS HC A03/MF A01 CSCL 20K

The feasibility of using the rapidly growing technology of the shape memory alloys actuators in actively controlling the buckling of large flexible structures is investigated. The need for such buckling control systems is becoming inevitable as the design trends of large space structures have resulted in the use of structural members that are long, slender, and very flexible. In addition, as these truss members are subjected mainly to longitudinal loading they become susceptible to structural instabilities due to buckling. Proper control of such instabilities is essential to the effective performance of the structures as stable platforms for communication and observation. Mathematical models are presented that simulate the dynamic characteristics of the shape memory actuator, the compressive structural members, and the associated active control system. A closed-loop computer-controlled system is designed, based on the developed mathematical models, and implemented to control the buckling of simple beams. The performance of the computer-controlled system is evaluated experimentally and compared with the theoretical predictions to validate the developed models. The obtained results emphasize the importance of buckling control and suggest the potential of the shape memory actuators as attractive means for controlling structural deformation in a simple and reliable way. Author

N89-15434*# Texas Univ., San Antonio. Div. of Engineering.
PROBABILISTIC ANALYSIS FOR FATIGUE STRENGTH DEGRADATION OF MATERIALS Annual Report
Lola Royce Jan. 1989 133 p
(Grant NAG3-867)
(NASA-CR-182844; NAS 1.26:182844) Avail: NTIS HC A07/MF A01 CSCL 20K

This report presents the results of the first year of a research program conducted for NASA-LeRC by the University of Texas at San Antonio. The research included development of methodology that provides a probabilistic treatment of lifetime prediction of structural components of aerospace propulsion systems subjected to fatigue. Material strength degradation models, based on primitive variables, include both a fatigue strength reduction model and a fatigue crack growth model. Linear elastic fracture mechanics is utilized in the latter model. Probabilistic analysis is based on simulation, and both maximum entropy and maximum penalized likelihood methods are used for the generation of probability density functions. The resulting constitutive relationships are included in several computer programs, RANDOM2, RANDOM3, and RANDOM4. These programs determine the random lifetime of an engine component, in mechanical load cycles, to reach a critical fatigue strength or crack size. The material considered was a cast nickel base superalloy, one typical of those used in the Space Shuttle Main Engine. Author

N89-15435*# Lockheed Missiles and Space Co., Palo Alto, CA. Research and Development Div.
THE COMPUTATIONAL STRUCTURAL MECHANICS TESTBED ARCHITECTURE. VOLUME 2: THE INTERFACE
Carlos A. Felippa Dec. 1988 212 p
(Contract NAS1-18444)
(NASA-CR-178386; NAS 1.26:178386; LMSC-D878511) Avail: NTIS HC A10/MF A01 CSCL 20K

This is the third set of five volumes which describe the software architecture for the Computational Structural Mechanics Testbed. Derived from NICE, an integrated software system developed at Lockheed Palo Alto Research Laboratory, the architecture is composed of the command language CLAMP, the command language interpreter CLIP, and the data manager GAL. Volumes 1, 2, and 3 (NASA CR's 178384, 178385, and 178386, respectively) describe CLAMP and CLIP and the CLIP-processor interface. Volumes 4 and 5 (NASA CR's 178387 and 178388, respectively) describe GAL and its low-level I/O. CLAMP, an acronym for Command Language for Applied Mechanics Processors, is designed to control the flow of execution of processors written for NICE. Volume 3 describes the CLIP-Processor interface and related topics. It is intended only for processor developers. Author

N89-15436*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A RE-EVALUATION OF FINITE-ELEMENT MODELS AND STRESS-INTENSITY FACTORS FOR SURFACE CRACKS EMANATING FROM STRESS CONCENTRATIONS
P. W. Tan, I. S. Raju, K. N. Shivakumar (Analytical Services and Materials, Inc., Hampton, VA.), and J. C. Newman, Jr. Nov. 1988 32 p
(NASA-TM-101527; NAS 1.15:101527) Avail: NTIS HC A03/MF A01 CSCL 20K

A re-evaluation of the 3-D finite-element models and methods used to analyze surface crack at stress concentrations is presented. Previous finite-element models used by Raju and Newman for surface and corner cracks at holes were shown to have ill-shaped elements at the intersection of the hole and crack boundaries. These ill-shaped elements tended to make the model too stiff and, hence, gave lower stress-intensity factors near the hole-crack intersection than models without these elements. Improved models, without these ill-shaped elements, were developed for a surface crack at a circular hole and at a semi-circular edge notch. Stress-intensity factors were calculated by both the nodal-force and virtual-crack-closure methods. Both methods and different models gave essentially the same results. Comparisons made between the previously developed stress-intensity factor equations and the results from the improved models agreed well except for configurations with large notch-radii-to-plate-thickness ratios. Stress-intensity factors for a semi-elliptical surface crack located at the center of a semi-circular edge notch in a plate subjected to remote tensile loadings were calculated using the improved models. The ratio of crack depth to crack length ranged form 0.4 to 2; the ratio of crack depth to plate thickness ranged from 0.2 to 0.8; and the ratio of notch radius to the plate thickness ranged from 1 to 3. The models had about 15,000 degrees-of-freedom. Stress-intensity factors were calculated by using the nodal-force method. Author

N89-15437*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
NONINTERACTIVE MACROSCOPIC RELIABILITY MODEL FOR CERAMIC MATRIX COMPOSITES WITH ORTHOTROPIC MATERIAL SYMMETRY
Stephen F. Duffy (Cleveland State Univ., OH.) and Jane M. Manderscheid [1989] 9 p Prepared for presentation at the 34th International Gas Turbine and Aeroengine Congress and Exposition, Toronto, Ontario, 4-8 Jun. 1989; sponsored by ASME
(NASA-TM-101414; E-4512; NAS 1.15:101414) Avail: NTIS HC A02/MF A01 CSCL 20K

A macroscopic noninteractive reliability model for ceramic matrix composites is presented. The model is multiaxial and applicable to composites that can be characterized as orthotropic. Tensorial invariant theory is used to create an integrity basis with invariants that correspond to physical mechanisms related to fracture. This integrity basis is then used to construct a failure function per unit volume (or area) of material. It is assumed that the overall strength of the composite is governed by weakest link theory. This leads to a Weibull type model similar in nature to the principle of independent action (PIA) model for isotropic monolithic ceramics. An experimental program to obtain model parameters is briefly discussed. In addition, qualitative features of the model are illustrated by presenting reliability surfaces for various model parameters. Author

N89-15438*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
FREE-VIBRATION CHARACTERISTICS AND CORRELATION OF A SPACE STATION SPLIT-BLANKET SOLAR ARRAY
Kelly S. Carney and Francis J. Shaker [1989] 15 p Prepared for presentation at the 30th Structures, Structural Dynamics and Materials Conference, Mobile, AL, 3-5 Apr. 1989; sponsored in part by AIAA, ASME, ASCE, AHS and ACS
(NASA-TM-101452; E-4563; NAS 1.15:101452) Avail: NTIS HC A03/MF A01 CSCL 20K

Two methods for studying the free-vibration characteristics of a large split-blanket solar array in a zero-g cantilevered configuration are presented. The zero-g configuration corresponds to an on-orbit configuration of the Space Station solar array. The first method applies the equations of continuum mechanics to determine the natural frequencies of the array; the second uses the finite element method program, MSC/NASTRAN. The stiffness matrix from the NASTRAN solution was found to be erroneously grounded. The results from the two methods are compared. It is concluded that the grounding does not seriously compromise the solution to the elastic modes of the solar array. However, the correct rigid body modes need to be included to obtain the correct dynamic model. Author

42 GEOSCIENCES (GENERAL)

No abstracts in this category.

43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N89-15439 Purdue Univ., West Lafayette, IN.
THE APPLICATION OF REMOTE SENSING TO GEOMORPHOLOGICAL MAPPING AND MASS MOVEMENT STUDY IN THE VICINITY OF PROVO, UTAH Ph.D. Thesis
Nabil Subhi Al-Daghastani 1987 414 p
Avail: Univ. Microfilms Order No. DA8807580

Analysis of National High Altitude Photography (NHAP) and LANDSAT Thematic Mapper data on the central Wasatch Range was used to evaluate the relative effectiveness of these products for geomorphological and structural mapping, and to determine the mass movement susceptibility of different landforms. The study area includes portions of the Basin and Range and Middle Rocky Mountains physiographic provinces near Provo, UT, as defined and subdivided into formal sections based on internal physiographic, structural, and geological elements. The present study subdivides these sections into smaller, discrete sectors and discriminates mappable geomorphological units within each sector. The geomorphic analysis is based on the premise that the land surface consists of units which are convexo-concave and convex-rectilinear in plan; each unit is bounded by slop discontinuities. Geomorphological maps at 1:250,000 and 1:100,000 scale made from LANDSAT TM data and Infrared Aerial Photographs provide basic information on distribution of unstable slopes and sites of previous slope failure. The NHAP aerial photographs provide the most accurate, complete portrayal of terrain, and better mass movement susceptible landforms than does TM data. Dissert. Abstr.

N89-15440# Instituto de Pesquisas Espaciais, Cachoeira Paulista (Brazil).
STUDY OF GEOMETRIC QUALITY OF THE MSS-LANDSAT IMAGERY
Antonio Jose F. MachadoeSilva Aug. 1988 18 p In PORTUGUESE; ENGLISH summary Presented at the 3rd Brazilian Symposium on Remote Sensing, Rio de Janeiro, Brazil, 28-30 Nov. 1984
(INPE-4653-PRE/1360) Avail: NTIS HC A03/MF A01

The present status of LANDSAT MSS imagery processing is discussed. Evaluation is done on images from all satellites of the LANDSAT series, both bulk and precision imagery. Root mean square errors obtained were 120 + or - 20 m for bulk images and 60 + or - 15 m for precision images. The causes of geometric distortion are given, both internal and external, and a simplified correction model is presented. The results of geometric evaluation of LANDSAT imagery are then given. Polynomials, from first to fifth degree, are tested in order to determine the best one for precision image generation. Author

N89-15441# Naval Ocean Research and Development Activity, Bay St. Louis, MS.
DESIGN AND IMPLEMENTATION OF THE DIGITAL WORLD VECTOR SHORELINE DATA FORMAT Final Report
Maura C. Lohrenz May 1988 38 p
(AD-A197919; NORDA-194) Avail: NTIS HC A03/MF A01 CSCL 08B

This report defines the data structure and format that NORDA designed for the Defense Mapping Agency's (DMA) digital World Vector Shoreline (WVS) data set. Methods of accessing the data set, current and future applications for WVS, and suggested future additions to the data set are also discussed. Applications and suggestions are based on responses to a questionnaire prepared by NORDA to survey DoD users who evaluated the latest WVS prototype. NORDA's role in designing the WVS data format and structure was a direct result of our recommendations to DMA on their original WVS prototype data set and format, presented in NORDA reports 146 and 154. In these reports, NORDA recommended that specific changes be made to DMA's original WVS to be sure that it would meet Navy requirements for a digital global shoreline map. In response, DMA requested that NORDA assist them in the design and implementation of a new WVS format and data structure. This new product was completed and distributed to potential Navy and other DoD users in March 1987. GRA

N89-15442# European Space Agency, Paris (France).
INVESTIGATION OF INFORMATION CONTENT OF THEMATIC MAPPER AND SPOT MULTIBAND IMAGE DATA, USING SIMULATED IMAGE DATA OF THE FREIBURG REGION (FEDERAL REPUBLIC OF GERMANY)
Werner Kirchhof, Wolfraum Mauser, and Hans-Juergen Stibig (Freiburg Univ., Germany, F.R.) Oct. 1988 139 p Transl. into ENGLISH of Untersuchung des Informationsgehaltes von Landsat-Thematic-Mapper-und SPOT-Multiband-Bilddatem mit Simulierten Multispektralen Bilddaten des Gebietes Freiburg (Oberpfaffenhofen, Fed. Republic of Germany, DFVLR) Original language document was announced as N86-21972 Original contains color illustrations
(ESA-TT-975; DFVLR-FB-85-49; ETN-89-93629) Avail: NTIS HC A07/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 52 Deutsche marks

A comparative analysis of information contents was performed using data sets with pixel sizes of 10, 20, 30, 50, and 80 m from LANDSAT TM simulation. The discrimination of objects, structures and texture, depending on pixel size and combination of spectral bands, was investigated by visual interpretation and supervised classification for applications in agriculture and forestry. The new TM bands produce significant improvements in the separation of vegetated and built-up areas as well as in the delineation of the status of growth and humidity in comparison with LANDSAT MSS. The Thematic Mapper is eminently suited for the extraction of thematic information of surface areas of 1 hectare or more. Three to four spectral bands are normally sufficient. The information content of 20 m SPOT multiband data does not differ essentially from that of comparable TM bands (TM2, TM3, TM4). A substantial complement to the TM information are structure and texture elements of the panchromatic 10 m SPOT band. ESA

N89-15443*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ESTIMATING THE SIGNAL-TO-NOISE RATIO OF AVIRIS DATA
Paul J. Curran and Jennifer L. Dungan (TGS Technology, Inc., Moffett Field, CA.) Nov. 1988 25 p
(NASA-TM-101035; A-88298; NAS 1.15:101035) Avail: NTIS HC A03/MF A01 CSCL 20N

To make the best use of narrowband airborne visible/infrared imaging spectrometer (AVIRIS) data, an investigator needs to know the ratio of signal to random variability or noise (signal-to-noise ratio or SNR). The signal is land cover dependent and varies with both wavelength and atmospheric absorption; random noise comprises sensor noise and intrapixel variability (i.e., variability within a pixel). The three existing methods for estimating the SNR are inadequate, since typical laboratory methods inflate while dark current and image methods deflate the SNR. A new procedure is proposed called the geostatistical method. It is based on the removal of periodic noise by notch filtering in the frequency domain and the isolation of sensor noise and intrapixel variability using the semi-variogram. This procedure was applied easily and successfully to five sets of AVIRIS data from the 1987 flying season and could be applied to remotely sensed data from broadband sensors. Author

N89-15444*# Scripps Institution of Oceanography, San Diego, CA.
A MULTI-SENSOR REMOTE SENSING APPROACH FOR MEASURING PRIMARY PRODUCTION FROM SPACE Final Technical Report
Catherine Gautier 10 Jan. 1989 62 p

(Grant NAGw-0851)
(NASA-CR-184662; NAS 1.26:184662) Avail: NTIS HC A04/MF A01 CSCL 08C

It is proposed to develop a multi-sensor remote sensing method for computing marine primary productivity from space, based on the capability to measure the primary ocean variables which regulate photosynthesis. The three variables and the sensors which measure them are: (1) downwelling photosynthetically available irradiance, measured by the VISSR sensor on the GOES satellite, (2) sea-surface temperature from AVHRR on NOAA series satellites, and (3) chlorophyll-like pigment concentration from the Nimbus-7/CZCS sensor. These and other measured variables would be combined within empirical or analytical models to compute primary productivity. With this proposed capability of mapping primary productivity on a regional scale, we could begin realizing a more precise and accurate global assessment of its magnitude and variability. Applications would include supplementation and expansion on the horizontal scale of ship-acquired biological data, which is more accurate and which supplies the vertical components of the field, monitoring oceanic response to increased atmospheric carbon dioxide levels, correlation with observed sedimentation patterns and processes, and fisheries management. Author

N89-15445*# Wyoming Univ., Laramie. Dept. of Atmospheric Science.

AN AIRBORNE STUDY OF MICROWAVE SURFACE SENSING AND BOUNDARY LAYER HEAT AND MOISTURE FLUXES FOR PROJECT FIFE Semiannual Status Report No. 3

Robert D. Kelly [1989] 48 p
(Grant NAG5-913)
(NASA-CR-182881; NAS 1.26:182881) Avail: NTIS HC A03/MF A01 CSCL 20F

This is the third semiannual status report describing the University of Wyoming participation in project FIFE, under NASA Grant NAG 5-913. The reader is referred to the first and second semiannual status reports for this grant for descriptions of University of Wyoming participation in the field operations of 1987. This report is concerned with continuing analysis of field data. Most of the instrument calibration effort has concentrated on interpretation and use of the high-rate water vapor measurements with the University of Wyoming Lyman-alpha device. In addition, fluxes of water vapor have been corrected for sensible heat flux, and all the high-rate (10 Hz for the Wyoming King Air) data have been filtered before the flux calculations. For each flight the Lyman-alpha data (10 Hz) are calibrated against the Cambridge dew-point hygrometer (1 Hz), by using data from the take-off sounding. The reasoning here is that the takeoff sounding (held to 500 fpm rate-of-climb specifically for the calibration) covers the widest range of humidity conditions of any sequence of the flight. For each takeoff sounding, then, the Lyman-alpha data, averaged to 1 Hz, are matched to the dewpoint data with a second-order least-squares fit. The resulting quadratic equation is then used in all subsequent analyses to convert the Lyman-alpha voltages to vapor desities for that specific flight. An alternative method is to use the range of fluctuation for the same two devices from horizontal passes to establish the calibration function. However, since the Lyman-alpha data are used only in the flux calculations, i.e., only the fluctuation and not the absolute values are used, this method is thought unnecessary. Author

N89-15446# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil). Ministerio da Ciencia e Tecnologia.

KNOWLEDGE RELATED ASPECTS OF LINEATION AND LINEAMENT EXTRACTION

Paulo OuveraSimoni, Valter Rodrigues, and Pedro Paulo BdeOliveira Sep. 1988 14 p Presented at the 5th Simposio Brasileiro de Inteligencia Artificial, Natal, Brazil, 7-11 Nov. 1988 Submitted for publication
(INPE-4709-PRE/1391) Avail: NTIS HC A03/MF A01

The problem of linear feature extraction from remote sensing images for structural geology analysis is discussed. The linear features extracted give valuable clues to geologists in the identification of the internal structure of the lithosphere. A number of factors may influence the extraction process besides the identification of small textural elements. A knowledge-based approach to develop a vision system for linear feature extraction is proposed for integrating these factors. Author

N89-15447# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil). Lab. Associado de Computacao e Matematica Aplicada.

USING DIFFERENT SOURCES OF INFORMATION IN AUTOMATED LINEAR FEATURE EXTRACTION FROM REMOTE SENSING DATA

Paulo OuveraSimoni, Valter Rodrigues, and Pedro Paulo BdeOliveira Sep. 1988 11 p Presented at the 5th Simposio Brasileiro de Sensoriamento Remoto, Natal, Brazil, 11-15 Oct. 1988
(INPE-4703-PRE/1390) Avail: NTIS HC A03/MF A01

The extraction of linear features from LANDSAT satellite images for structural geology applications is analyzed. Also discussed is the influence of a number of factors such as sensor type, position of the observer, shadowing and knowledge about dominant structures, over the inference of relief convexity, the detection of linear features and the type of feature. The integration of these factors is then studied in the context of an automated linear feature extraction process under specification and the desirability of a knowledge representation model for combining all the available sources of information that are important for the extraction process is argued. Author

N89-15448*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

MODIS INFORMATION, DATA, AND CONTROL SYSTEM (MIDACS) SYSTEM SPECIFICATIONS AND CONCEPTUAL DESIGN

D. Han, V. Salomonson, J. Ormsby, P. Ardanuy, A. McKay, D. Hoyt, S. Jaffin, B. Vallette, B. Sharts, and D. Folta (General Sciences Corp., Laurel, MD.) et al Dec. 1988 122 p Prepared in cooperation with Interferometrics, Inc., Vienna, VA
(Contracts NAS5-29373; NAS5-28795)
(NASA-TM-100721; Rept-89B00065; NAS 1.15:100721) Avail: NTIS HC A06/MF A01 CSCL 05B

The MODIS Information, Data, and Control System (MIDACS) Specifications and Conceptual Design Document discusses system level requirements, the overall operating environment in which requirements must be met, and a breakdown of MIDACS into component subsystems, which include the Instrument Support Terminal, the Instrument Control Center, the Team Member Computing Facility, the Central Data Handling Facility, and the Data Archive and Distribution System. The specifications include sizing estimates for the processing and storage capacities of each data system element, as well as traffic analyses of data flows between the elements internally, and also externally across the data system interfaces. The specifications for the data system, as well as for the individual planning and scheduling, control and monitoring, data acquisition and processing, calibration and validation, and data archive and distribution components, do not yet fully specify the data system in the complete manner needed to achieve the scientific objectives of the MODIS instruments and science teams. The teams have not yet been formed; however, it was possible to develop the specifications and conceptual design based on the present concept of EosDIS, the Level-1 and Level-2 Functional Requirements Documents, the Operations Concept, and through interviews and meetings with key members of the scientific community. Author

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

N89-15449# Air Force Inst. of Tech., Wright-Patterson AFB, OH.

COMPARISON OF PHOTOVOLTAIC ENERGY SYSTEMS FOR THE SOLAR VILLAGE M.S. Thesis

Eric C. PierceFrench Aug. 1988 167 p

(AD-A200009; AFIT/CI/NR-88-184) Avail: NTIS HC A08/MF A01 CSCL 10B

Three different solar photovoltaic (PV) energy systems are compared to determine if the electrical needs of a solar village could be supplied more economically by electricity generated by the sun than by existing utility companies. The solar village, a one square mile community of 900 homes and 50 businesses, would be located in a semi-remote area of the Arizona desert. A load survey is conducted and information on the solar PV industry is reviewed for equipment specifications, availability, and cost. Three specific PV designs, designated as Stand-Alone, Stand-Alone with interconnection, and Central Solar Plant, were created and then economically compared through present worth analysis against utility supplied electrical costs. A variety of technical issues, such as array protection, system configuration and operation, and practicability, are discussed for each design. The present worth analysis conclusively shows none of the solar PV designs could supply electricity to the solar village for less cost than utility supplied electricity, all other factors being equal. No construction on a solar village should begin until the cost of solar generated electricity is more competitive with electricity generated by coal, oil, and nuclear energy. However, research on ways to reduce solar PV equipment costs and on ways to complement solar PV energy, such as the use of solar thermal ponds for heating and cooling, should continue. GRA

N89-15450# Sandia National Labs., Albuquerque, NM.

THE COSTS OF PHOTOVOLTAIC CONCENTRATOR MODULES

Jay L. Chamberlin 1988 4 p Presented at the 20th IEEE Photovoltaic Specialists Conference, Las Vegas, NV, 26 Sep. 1988

(Contract DE-AC04-76DP-00789)

(DE89-000501; SAND-88-0593C; CONF-880965-5) Avail: NTIS HC A02

The United States Department of Energy (DOE) has established 30-year levelized electricity cost goals for photovoltaically generated energy. These goals are $0.12/kWh for the near-term (early 1990s) and $0.06/kWh for the year 2000. The details of these goals are presented in DOE's Five Year Research Plan. Sandia National Laboratories, which conducts and directs various photovoltaic (PV) research programs for the DOE, monitors the progress of industry in approaching these goals by periodically analyzing the projected costs of such power generation systems. The results of the most recent of these comparative studies for PV concentrator modules are presented in this paper. Based upon module cost projections supplied by six module developers, it is likely that the near-term goal could be met given sufficient production volume. Further cost reductions, which will require innovative module designs, are necessary to meet the longer term goal. DOE

N89-15451# Sandia National Labs., Albuquerque, NM.

PERFORMANCE MODELING OF LEAD-ACID BATTERIES IN PHOTOVOLTAIC APPLICATIONS

Jay L. Chamberlin 1988 7 p Presented at the 20th IEEE Photovoltaic Specialists Conference, Las Vegas, NV, 26 Sep. 1988

(Contract DE-AC04-76DP-00789)

(DE89-000502; SAND-88-0594C; CONF-880965-6) Avail: NTIS HC A02

The modeling of photovoltaic (PV) systems requires accurate descriptions of the performance of the system's individual subsystems and their interrelationships. For stand-alone application simulations, this requires an effective model of the energy storage subsystem, which generally consists of lead-acid batteries and their associated charge controller. A test of five lead-acid batteries of four generic types was conducted to determine the effectiveness of the energy storage subsystem's model used in Sandia's PV systems' simulation code PVFORM. While PVFORM accurately represented an adequately charged battery operating in a system with little excess array energy, considerable care was required in establishing the model's user-defined input parameters to describe the more typical performance of a battery when used with a controller that does not maximize the array's utilization. Causes for this poorer-than-expected battery performance are presented along with their impact on both system design and performance modeling. DOE

N89-15452# Argonne National Lab., IL.

ARGONNE MONOLITHIC SOLID OXIDE FUEL CELL FABRICATION

C. C. McPheeters, D. W. Dees, S. E. Dorris, and J. J. Picciolo 1988 4 p Presented at the 11th Fuel Cell Seminar: Development and Application of Fuel Cells for the 90s, Long Beach, CA, 23 Oct. 1988

(Contract W-31-109-eng-38)

(DE89-000607; CONF-881010-2) Avail: NTIS HC A02/MF A01

The Monolithic Solid Oxide Fuel Cell (MSOFC) under development at Argonne National Laboratory is an oxide-ceramic structure in which appropriate electronic and ionic conductors are fabricated in a honeycomb shape similar to a block of corrugated paperboard. The electrolyte conducts oxygen ions from the air side to the fuel side and is made from yttria-stabilized zirconia (YSZ). All the other materials are electronic conductors, including the nickel-YSZ anode, the strontium-doped lanthanum manganite cathode, and the doped lanthanum chromite interconnect (bipolar plate). These electronic and ionic conductors are arranged so that they provide short conduction paths to minimize resistive losses. The power density achievable with the MSOFC is expected to be 8 kW/kg or about 4 kW/L because of the small cell size and low resistive loses in the materials. The MSOFC operates in the range of 700 to 1000 C, at which temperatures rapid reform of hydrocarbon fuels is expected within the nickel-YSZ fuel channels. DOE

N89-15453# California Univ., Berkeley. Lawrence Berkeley Lab.

TECHNOLOGY BASE RESEARCH PROJECT FOR ELECTROCHEMICAL ENERGY STORAGE Executive Summary Report, 1987

K. Kinoshita, ed. Jun. 1988 20 p

(Contract DE-AC03-76SF-00098)

(DE88-016121; LBL-25506) Avail: NTIS HC A03/MF A01

The U.S. Department of Energy's Office of Energy Storage and Distribution provides continuing support for an Energy Storage Program, which includes R and D on advanced electrochemical energy storage and conversion systems. A major goal of this program is to develop electrochemical power sources suitable for application in electric vehicles and/or electric load-leveling devices. The program centers on advanced secondary batteries and fuel cells that offer the potential for high performance and low life-cycle costs, both of which are necessary to permit significant penetration into commercial markets. DOE

N89-15454# Sandia National Labs., Albuquerque, NM. Computational Aerodynamics Div.

VAWT (VERTICAL-AXIS WIND TURBINES) STOCHASTIC LOADS USING A 3-D TURBULENCE SIMULATION

Gregory F. Homicz 1988 11 p Presented at the 18th National Conference of the American Wind Energy Association, Honolulu,

HI, 19 Sep. 1988
(Contract DE-AC04-76DP-00789)
(DE89-001371; SAND-88-0916C; CONF-880916-2) Avail: NTIS HC A03/MF A01

The stochastic (i.e., random) aerodynamic loads created by atmospheric turbulence are thought to be a primary cause of premature blade fatigue in Vertical-Axis Wind Turbines (VAWTs). This paper describes a computer program for the prediction of these stochastic loads, based on a full 3-D simulation of the turbulence field. Computed results using this model are compared with the deterministic (periodic) loads which occur in the absence of turbulence, and with the predictions of an earlier model which employed a 1-D simulation of the turbulence. The results show that not only are instantaneous loads significantly influenced by turbulence, but that load distributions averaged over numerous revolutions are affected as well. A particularly interesting finding is that, for the same mean wind speed, the average output power is altered by turbulence. DOE

N89-15455# Midwest Research Inst., Golden, CO. Solar Energy Research Inst.
RESEARCH ON HIGH-EFFICIENCY, SINGLE-JUNCTION, MONOLITHIC, THIN-FILM AMORPHOUS SILICON SOLAR CELLS Annual Report, 1 Oct. 1984 - 30 Sep. 1985
A. E. Delahoy, E. Eser, and F. Kampas Sep. 1988 173 p
Prepared in cooperation with Chronar Corp., Princeton, NJ
(Contract DE-AC02-83CH-10093)
(DE89-000812; SERI/STR-211-3406) Avail: NTIS HC A08/MF A01

Kinetics of light-induced degradation and thermal recovery of the photoconductivity in a-Si:H have been investigated. Rate equations for these processes were derived using the principles of reaction rate theory. Both degradation and recovery were found to be thermally activated with activation energies of 0.1eV and 1.35eV, respectively. Experimental results support the bond breaking model for the degradation. Stabilization of broken bonds is achieved by structural relaxation. Thermal recovery proceeds through hydrogen hopping from one dangling bond to another. Experimental evidence suggests the existence of an upper limit in the density of light-induced defects. A microscopic model, consistent with experimental observations, is proposed for the light-induced generation and thermal recovery of defects in a-Si:H. DOE

N89-15456*# Washington Univ., Seattle. Aerospace and Energetics Research Program.
BASIC AND APPLIED RESEARCH RELATED TO THE TECHNOLOGY OF SPACE ENERGY CONVERSION SYSTEMS Semiannual Report, 8 Feb. - 8 Aug. 1988
A. Hertzberg, A. T. Mattick, and A. P. Bruckner 1988 17 p
(Grant NAG1-327)
(NASA-CR-184644; NAS 1.26:184644) Avail: NTIS HC A03/MF A01 CSCL 10A

The first six months' research effort on the Liquid Droplet Radiator (LDR) focussed on experimental and theoretical studies of radiation by an LDR droplet cloud. Improvements in the diagnostics for the radiation facility have been made which have permitted an accurate experimental test of theoretical predictions of LDR radiation over a wide range of optical depths, using a cloud of Dow silicone oil droplets. In conjunction with these measurements an analysis was made of the evolution of the cylindrical droplet cloud generated by a 2300-hole orifice plate. This analysis indicates that a considerable degree of agglomeration of droplets occurs over the first meter of travel. Theoretical studies have centered on developments of an efficient means of computing the angular scattering distribution from droplets in an LDR droplet cloud, so that a parameter study can be carried out for LDR radiative performance vs fluid optical properties and cloud geometry. Author

45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

N89-15457 Maryland Univ., College Park.
OBSERVATIONS OF TROPOSPHERIC TRACE GASES AND TECHNIQUES FOR ASSESSING THE REGIONAL TRANSPORT OF AIR POLLUTANTS Ph.D. Thesis
Kenneth Edward Pickering 1987 378 p
Avail: Univ. Microfilms Order No. DA8808595

Two techniques were used to assess regional transport of gaseous air pollution. The first involved conducing airborne measurements of vertical profiles of the trace gases CO, O3, and reactive nitrogen compounds near convective clouds, followed by analysis and interpretation with detailed meteorological data. The second technique involved applying spectral and cross spectral analyses to surface-based time series of simultaneous trace gas concentrations and wind data. Dissert. Abstr.

N89-15458*# Kentucky Univ., Lexington. Dept. of Chemical Engineering.
A STUDY OF CARBON MONOXIDE DISTRIBUTION DETERMINATIONS FOR A GLOBAL TRANSPORT MODEL Final Report
Leonard K. Peters 7 Dec. 1988 15 p
(Grant NAG1-707)
(NASA-CR-184553; NAS 1.26:184553) Avail: NTIS HC A03/MF A01 CSCL 13B

The primary objective of this grant was to further the development of a global transport/chemistry model that simulates the physico-chemical behavior of methane and carbon monoxide in the troposphere. The computer simulation model is designed to analyze the processes that occur as methane and carbon monoxide are transported from their respective sources to their ultimate fate, e.g., final conversion to CO2, transport to the stratosphere, deposition at ground level, etc. Author

N89-15459 Wyoming Univ., Laramie.
MEASUREMENTS OF SPRINGTIME ANTARCTIC OZONE DEPLETION AND DEVELOPMENT OF A BALLOONBORNE ULTRAVIOLET PHOTOMETER Ph.D. Thesis
Jerald William Harder 1987 244 p
Avail: Univ. Microfilms Order No. DA8813304

The research described consists of two parts. The first part is a description of the design of a balloonborne ultraviolet photometer to measure ozone and the results of a flight using this instrument. The second part describes the modifications made on the standard commercially available electrochemical ozonesonde and the results of some experiments performed both in the lab and during stratospheric balloon flights. Using this modified ECC system, 33 successful balloon flights were made at McMurdo Station, Antarctica during the austral spring of 1986 to study the temporal and vertical development of the so-called Antarctic Ozone Hole. The results of these flights are described in detail. The ozonesonde data gave a very clear picture of the development of the Ozone Hole. Dissert. Abstr.

N89-15460# New York Univ., Tuxedo. Inst. of Environmental Medicine.
SAMPLING AIRBORNE RADIOACTIVITY
B. S. Cohen 1988 1 p Presented at the American Industrial Hygiene Conference, San Francisco, CA, 15 May 1988
(Contract DE-FG02-87ER-60592)
(DE88-013091; DOE/ER-60592/5; CONF-8805186-1) Avail: NTIS HC A02/MF A01

Radioactive contaminants have historically been considered apart from chemical contaminants because it is their radiological properties that determine their biological and environmental impact. Additionally they have been regulated by special government agencies concerned with radiological protection. Radioactive contaminants are also distinguished by the specialized and very sensitive methods available for the detection of radioactivity. Measurements of a few thousand atoms per liter are not

uncommon. Radiation detectors in common use are gas filled chambers, scintillation and semiconductor detectors, and the more recently developed thermoluminescent and etched track detectors. Solid-state nuclear track detectors consist of a large group of inorganic and organic dielectrics which register tracks when traversed by heavy charged particles. They do not respond to light, beta particles or gamma ray photons and thus provide a very low background system for the detection of extremely low levels of radioactivity. In addition, no power source or electronic equipment is required. Cellulose nitrate detectors are currently in use for long term integrated sampling of environmental radon. Thermoluminescent dosimeters (TID's) are crystalline materials, in which electrons which have been displaced by an interaction with ionizing radiation become trapped at an elevated energy level and emit visible light when released from that energy level. As which etched-track detectors no power or electronic equipment is needed for the TID's at a measurement site, but they respond to alpha, beta and gamma radiation. Thermoluminescent dosimeters are useful for long term environmental monitoring, and have also been newly incorporated into integrating radon detection systems. DOE

N89-15461# Lawrence Livermore National Lab., CA.
SENSITIVITY OF URBAN/REGIONAL CHEMISTRY TO CLIMATE CHANGE: REPORT OF THE WORKSHOP
Donald J. Wuebbles and J. E. Penner Jul. 1988 116 p Workshop held in Chapel Hill, NC, 17 Feb. 1988
(Contract W-7405-eng-48)
(DE88-017029; UCRL-99436; CONF-8802108-Summ) Avail: NTIS HC A06/MF A01

This report is a summary of a special workshop sponsored by the Environmental Protection Agency concerning the potential impacts of climate change on urban and regional air quality. Attendees at the workshop included representatives from key research groups in the modeling of urban and regional processes, experts in climate and atmospheric chemistry, and EPA technical and administrative staff. A basic finding of the workshop was that only a very limited number of studies on the sensitivity of urban/regional models to climate change currently exist; much more remains to be done. Additional model development and additional laboratory and atmospheric data are needed before the effects of climate change can be fully understood. An action plan for future research was suggested at the workshop. DOE

N89-15462# Acurex Corp., Mountain View, CA. Environmental Systems Div.
VOLATILE ORGANIC COMPOUND AND PARTICULATE EMISSION STUDIES OF AF (AIR FORCE) PAINT BOOTH FACILITIES Final Report, Feb. - Dec. 1987
Jacqueline Ayer and Dean Wolbach Jul. 1988 105 p
(AD-A198092; AFESC/ESL-TR-87-55) Avail: NTIS HC A06/MF A01 CSCL 24A

This study presents the results of volatile organic compound (VOC) and particulate emission surveys performed at three Air Force painting facilities. The three facilities -- one in McClellan AFB buildings 655 and two at Travis AFB in buildings 550 and 1014 -- did not meet local VOC emission standards. This report discusses the possibility of reducing these emissions with recirculation modifications and various VOC reduction and control strategies. Although VOC emissions from paint spray booths can be controlled by add-on control systems, control is expensive for present air flow rates. The use of air recirculation within the spray booth can reduce the cost of VOC emission controls by reducing the quantity of air which requires processing. Recirculation systems were designed for two of the painting facilities included in this study. In designing the systems, various criteria such as paint booth VOC concentrations and health and safety standards were considered. Add-on VOC emission control systems which can be used in conjunction with the recirculation system are evaluated in this study. The devices of interest are a solvent incineration system and an activated carbon adsorption bed. The VOC removal efficiency, initial capital investment and operating costs for both of these technologies are discussed. GRA

N89-15463# Sigma Research, Inc., Lexington, MA.
STUDY OF TURBULENT CONCENTRATION FLUCTUATIONS Final Report, 1 May 1985 - 30 Apr. 1988
Steven R. Hanna 30 Jun. 1988 46 p
(Contract DAAG29-85-C-0011)
(AD-A198526; A005; ARO-22615.5-GS) Avail: NTIS HC A03/MF A01 CSCL 01A

The literature on turbulent concentration in atmospheric smoke plumes is reviewed and new models developed for predicting the statistical characteristics of these fluctuations, including the mean and the variance. A method for estimating the integral time scale for concentration fluctuations is suggested, and it is shown how this time scale can be used to calculate the effects of averaging and sampling times on the total variance. The spectra and cross-spectra of concentration and wind speed fluctuations are investigated using data from several field and laboratory experiments, leading to generalizations regarding spectral shape and phase relations between the concentration and wind speed time series. GRA

N89-15464# Lawrence Livermore National Lab., CA. Atmospheric and Geophysical Sciences Div.
A STUDY OF THE SENSITIVITY OF STRATOSPHERIC OZONE TO HYPERSONIC AIRCRAFT EMISSIONS
Donald E. Kinnison, Donald J. Wuebbles, and Harold S. Johnston Sep. 1988 6 p Presented at the 1st International Conference on Hypersonics Flight in the 21st Century, Grand Forks, IN, 20 Sep. 1988
(Contracts W-7405-eng-48; DE-AC03-76SF-00098)
(DE89-001240; UCRL-98314; CONF-8809167-1) Avail: NTIS HC A02/MF A01

There is new interest in the development of faster and more efficient aircraft for intercontinental passenger flights. Such aircraft would likely spend a high fraction of their flight time in the stratosphere. As a natural progression from studies that were done during the CIAP Program in the mid 1970s, this study investigates the sensitivity of stratospheric ozone to NO(sub x) and HO(sub x) emissions in conjunction with current understanding of atmospheric chemical and physical processes. The LLNL 1-D and 2-D chemical-radiative-transport models of the troposphere and stratosphere are used. Because of the significant uncertainties in possible future emissions, it is necessary that we examine the model's sensitivity to a wide range in magnitude, altitude, and latitude of assumed emissions. As well as examining different NO(sub x) and HO(sub x) emission levels, attempts are also made to examine the sensitivity of ozone to emissions under different background amounts of stratospheric chlorine (ClX). These studies lay the groundwork for future studies aimed at analyses of more realistic aircraft emission scenarios. DOE

N89-15465# Oak Ridge National Lab., TN. Energy Div.
OZONE POLLUTION: THE HARD CHOICES
Milton Russell Sep. 1988 52 p
(Contract DE-AC05-84OR-21400)
(DE89-001329; ORNL/TM-10909) Avail: NTIS HC A04/MF A01

This paper examines tropospheric ozone pollution and alternative approaches for dealing with it. Its underlying message is that Congress should not act on any of the measures now before it to amend the Clean Air Act with regard to ozone. The paper examines the origins and health and environmental effects of ozone pollution and describes the magnitude of the present problem. It summarizes what would be required to attain the current Clean Air Act goals and finds that they may be unattainable in practice in some locations. It concludes that the Clean Air Act is flawed, and that a public debate should be encouraged on fundamental changes in its goals and framework. DOE

N89-15466# Lawrence Livermore National Lab., CA.
SENSITIVITY STUDY OF GLOBAL OZONE TO NO(SUB x) EMISSION FROM AIRCRAFT
Donald E. Kinnison, H. Johnston (California Univ., Berkeley. Lawrence Berkeley Lab.), and Donald J. Wuebbles Aug. 1988

5 p Presented at the International Quadrennial Ozone Symposium, Gottingen, Fed Republic of Germany, 8-13 Aug. 1988
(Contract W-7405-eng-48)
(DE88-015433; UCRL-99361; CONF-8808102-2) Avail: NTIS HC A02/MF A01

There is renewed interest in the development of faster and more efficient aircraft for intercontinental passenger flights. Such aircraft would probably spend a large fraction of their flight time in the stratosphere, perhaps as high as 35 km. As a natural progression from studies that were done in the early 1970s, this study reinvestigates the sensitivity of stratospheric ozone to NO(sub x) emissions based on current understanding of atmospheric chemical and physical processes. The LLNL one-dimensional and new two-dimensional chemical-radiative-transport models of the troposphere and stratosphere are used. The 2-D model provides latitudinal, altitudinal, and seasonal resolution; and the computationally faster 1-D model is used for sensitivity studies. Because of uncertainties in possible future emissions, it is necessary to examine the model sensitivity to a wide range in magnitude, altitude, and latitude of assumed NO(sub x) emissions. As an initial study, the models are used in simulation of a typical scenario from the CIAP era, and results are compared with those of a published 2-D model, which includes some 3-D features. This investigation lays the groundwork for future studies, including different background amounts of ClX and for other aircraft emission scenarios. DOE

N89-15467# Pacific Northwest Labs., Richland, WA.
OZONE MEASUREMENT USING THE CHAPPUIS BAND IN THE VISIBLE SPECTRAL REGION
B. A. LeBaron and J. J. Michalsky (State Univ. of New York, Albany.) Aug. 1988 12 p Presented at the International Radiation Symposium, Lille, France, 18 Aug. 1988
(Contract DE-AC06-76RL-01830)
(DE88-015940; PNL-SA-16139; CONF-8808125-2) Avail: NTIS HC A03/MF A01

Our goal in this paper is to investigate methods of estimating total column ozone abundance using the Chappuis band especially in the presence of a severe perturbation to the stratospheric aerosol layer. DOE

N89-15468*# Search for Extraterrestrial Intelligence Inst., Los Altos, CA.
N2O FLUXES AT THE SOIL-ATMOSPHERE INTERFACE IN VARIOUS ECOSYSTEMS AND THE GLOBAL N2O BUDGET Final Report, 1 Oct. 1985 - 30 Jun. 1987
Amos Banin 1987 14 p
(Contract NCC2-385)
(NASA-CR-184642; NAS 1.26:184642) Avail: NTIS HC A03/MF A01 CSCL 13B

The overall purpose of this research task is to study the effects of soil properties and ecosystem variables on N2O exchanges at the soil-atmosphere interface, and to assess their effects on the globle N2O budget. Experimental procedures are implemented in various sites to measure the source/sink relations of N2O at the soil-atmosphere interface over prolonged periods of time as part of the research of biogeochemical cycling in terrestrial ecosystems. A data-base for establishing quantitative correlations between N2O fluxes and soil and environmental parameters that are of potential use for remote sensing, is being developed. Author

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N89-15469 Oregon State Univ., Corvallis.
AN EXAMINATION OF STRUCTURE AND PARAMETERIZATION OF TURBULENCE IN THE STABLY-STRATIFIED ATMOSPHERIC BOUNDARY LAYER Ph.D. Thesis
Paul Harold Ruscher 1987 183 p
Avail: Univ. Microfilms Order No. DA8806927

The very stable boundary layer is a region of the atmosphere typified by large vertical gradients of temperature and momentum. Analysis of very stable atmospheric flows is complicated by the presence of nonlinear interactions among gravity waves, shear driven overturning circulations, 2-D vortical modes and intermittent turbulence in various stages of development. The horizontal structure of a very stable atmospheric boundary layer is examined, using data obtained from terrain following aircraft flights over central Oklahoma. Several diagnostic procedures are applied to the aircraft data, including classical and rotary spectral analysis, principal component analysis, and structure functions. Coherent structures with sharp boundaries are examined with a new conditional sampling technique which requires little a priori specification of sampling criteria. The presence of significant turbulence even for a large stability has implications for modelling of the very stable boundary layer. Forecasts of minimum temperature, boundary layer height, inversion characteristics, and pollutant dispersal are all significantly affected by turbulent mixing. Dissert. Abstr.

N89-15470 Maryland Univ., College Park.
RECEPTOR MODELLING OF ATMOSPHERIC PARTICLES AND ACIDIC GASES, VOLUMES 1 AND 2 Ph.D. Thesis
Michael Everette Kitto 1987 468 p
Avail: Univ. Microfilms Order No. DA8808572

Samples of atmospheric particles and acidic gases were simultaneously collected using a stacked filter train consisting of a Teflon-based prefilter followed by four LiOH-treated Whatman-41 filters. The collected samples were analyzed by neutron-capture prompt gamma-ray and instrumental neutron activiation analysis for 45 to 50 elements. The base-treated filters quantitatively collected acidic gas-phase species of B, S, Cl, As, Se, Br, Sb, I and Hg. Boron, S, and As species were found only as acidic gases, while the others had both acidic and nonacidic contributions. Concentration ratios of several trace elements relative to Se, used to identify distant source regions, generally agreed with other reported values, but the need for updated regional signatures was apparent. Factor analysis was moderately successful in distinguishing four components. Though mixing between factors was evident, factor assignments included soil, oil combustion, gas-phase elements, and the particulate phase of the gaseous elements. Chemical mass balances were used to resolve elemental concentrations for each sample into nine components: coal, oil and refuse combustion, soil, limestone and marine aerosol, emissions from refineries and motor vehicles, and regional sulfate. Dissert. Abstr.

N89-15471* Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric and Planetary Sciences.
STRUCTURAL CONSTRAINTS ON CRUSTAL SHORTENING IN THE BOLIVIAN ANDES Ph.D. Thesis Final Technical Report, 15 Mar. 1984 - Aug. 1988
Barbara Moths Sheffels and Peter Molnar 23 Nov. 1988 326 p
(Grant NAG5-300)
(NASA-CR-184599; NAS 1.26:184599) Avail: Issuing Activity CSCL 08G

The Bolivian Andes lie within an active, convergent plate margin in which oceanic lithosphere is subducted beneath continental. As such, they provide the opportunity to assess the relative importance of processes which contribute to mountain-building. Specifically,

the roles of crustal shortening and of magnetic addition in the formation of the thickened crust and high elevations observed in the Bolivian Andes today have been the subject of much debate. Quantification of the amount of crustal shortening using balanced cross sections contributes to the resolution of this debate, and provides a key piece of data that can be used to test other hypothesis about mountain building. Substantially shortened fold and thrust belts are postulated to be related uniquely to collision, and to form in an orientation synthetic to that of the subduction zone. The large amount of crustal shortening in the Bolivian Andes, however, has been a response to subduction of oceanic lithosphere only. It has not been driven either by collision, since there is no evidence of Tertiary collisions, or by compression generated by intrusion of magma, since magmatic material does not form a volumetrically important part of the mountain belt. Furthermore, although the sense of overthrusting in the Bolivian back-arc fold and thrust belt is antithetic to that of the subduction zone, it has accommodated substantial crustal shortening. These observations must be taken into account when using the Andean margin as an analog for other orogenic belts. Author

N89-15472# Utah Univ., Salt Lake City. Dept. of Meteorology.
REMOTE SOUNDING OF ATMOSPHERIC TEMPERATURE PROFILES USING THE DIFFERENTIAL INVERSION METHOD Final Report, 1 May 1987 - 30 Apr. 1988
Kuo-Nan Liou and Szu-Cheng S. Ou 15 Jun. 1988 51 p
(Contract F19628-87-K-0042)
(AD-A199896; AFGL-TR-88-0152) Avail: NTIS HC A04/MF A01 CSCL 04B

The differential inversion method (DIM) is presented in the context of the fundamental principles governing the transfer of radiation for plane-parallel atmospheres in local thermodynamic equilibrium. In the Laplace inverse plane, the Planck intensity is linearly related to upwelling radiances weighted by the weighting function. By applying the inverse transform, the local Planck intensity can be exactly expressed by a linear combination of the derivatives of upwelling radiances in the logarithmic pressure coordinate. Using seven HIRS channels, numerical analyses of the DIM for temperature retrievals are carried out. Results based on distinct U.S. standard and tropical profiles show that the DIM converges to the true temperature solution with an accuracy of 102 K for tropospheric temperatures using a fifth-order polynomial function to fit seven HIRS radiances. The DIM appears to be an efficient and powerful retrieval method for temperatures. It is free from the need for a priori data basing and requires no constraints in the retrieval. Finally, it is pointed out that the key to the success of the DIM for practical applications appears to depend on whether an appropriate curve-fitting program can be developed for observed radiances. GRA

N89-15473# Teledyne Geotechnical, Garland, TX.
TEST REPORT ON THE MODEL 44000 SEISMOMETER SYSTEM
Aug. 1988 31 p
(Contract F08606-84-C-0023; DARPA Order 3328)
(AD-A199900; TR-88-9) Avail: NTIS HC A03/MF A01 CSCL 08K

Teledyne Geotech has completed long period subsurface vault tests on four individual 44000 modules; two horizontal and two vertical. Each type of module is tested in tandem by comparing the outputs of aligned sensors. The latest data is outstanding, particularly that of the horizontal. At a period of 20 seconds, both vertical and horizontal channels show incoherent noise power of approximately-180 dB relative to 1 (m/sec-sq)sq/Hz. At a period of 64 seconds, the horizontal data is some 20 dB quieter than any previous borehole data and furthermore shows no increase with period, even at periods as long as 250 seconds. This performance is remarkable for a non-borehole installation. The vertical data shows excellent performance, although some temperature effects seem to be present. A detailed explanation of the experimental history and current tests follows. GRA

N89-15474# Northwest Research Associates, Inc., Bellevue, WA.
STUDIES OF INTERNAL WAVE/MEAN FLOW INTERACTIONS Final Report, 1 Nov. 1986 - 30 Apr. 1988
Donald P. Delisi 27 Jun. 1988 94 p
(Contract F49620-86-C-0015)
(AD-A199949; NWRA-CR-88-R029; AFOSR-88-1003TR) Avail: NTIS HC A05/MF A01 CSCL 20D

A laboratory facility to observe internal gravity wave/mean flow interactions is described, and results from experiments are presented. The laboratory measurements include density measurements, instantaneous and mean velocity measurements, and shadowgraph observations. The results show that early wavebreaking in turbulent critical layers is characterized by Kelvin-Helmholtz instability and is not convective, as reported in earlier studies. The vertical location of the early over-turning moves progressively toward the gravity wave source and is correlated with observed mean flow modifications. Late-time gravity wave/critical layer interactions are characterized by steady-state mixing regions which are phase-locked to incoming gravity waves. Results from numerical simulations are also presented and are qualitatively similar to the early-time laboratory measurements. GRA

N89-15475# Massachusetts Inst. of Tech., Cambridge. Earth Resources Lab.
INFLUENCE OF SCATTERING ON SEISMIC WAVES: VELOCITY AND ATTENUATION OF THE UPPER CRUST IN SOUTHEAST MAINE Scientific Report No. 3, 1 Feb. - 31 Jul. 1987
Edmund Reister, Anton M. Dainty, and M. N. Toksoez 21 Mar. 1988 56 p
(Contract F19628-86-K-0004)
(AD-A199131; AFGL-TR-88-0094) Avail: NTIS HC A04/MF A01 CSCL 08K

Rg and Pg velocities and Rg attenuation have been examined for the Central Merrimack Synclinorium and nearby regions in southeastern Maine using digital records from a seismic refraction experiment. Determination of Rg group velocities and Pg travel times indicates that both lateral variations and azimuthal anisotropy are present in the study area. The axes of the azimuthal velocity anisotropy appear to lie along and perpendicular to the Appalachian structural strike in the region, with Rg group velocities along strike up to 20 percent faster than cross strike velocities. Measurement of Rg attenuation gives Q values of 25 to 80, varying with frequency. Inversion of the Rg group velocity for velocity structure shows that both the compressional and shear velocities increase rapidly with depth in the upper 1 km in the region. GRA

N89-15476*# Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric, and Planetary Sciences.
GEODETIC MEASUREMENT OF DEFORMATION IN CALIFORNIA Ph.D. Thesis
Jeanne Marie Sauber Nov. 1988 219 p
(Grants NAG5-814; NGT-50103; NAG5-459)
(NASA-CR-184604; NAS 1.26:184604) Copyright Avail: NTIS HC A10/MF A01 CSCL 08G

The very long baseline interferometry (VLBI) measurements made in the western U.S. since 1979 as part of the NASA Crustal Dynamics Project provide discrete samples of the temporal and spatial deformation field. The interpretation of the VLBI-derived rates of deformation requires an examination of geologic information and more densely sampled ground-based geodetic data. In the first two of three related studies embodying this thesis triangulation and trilateration data measured on two regional networks are processed, one in the central Mojave Desert and one in the Coast Ranges east of the San Andreas fault. At the spatial scales spanned by these local geodetic networks, auxiliary geologic and geophysical data have been utilized to examine the relation between measured incremental strain and the accommodation of strain seen in local geological structures, strain release in earthquakes, and principal stress directions inferred from in situ measurements. In the third study, VLBI data from stations

distributed across the Pacific - North American plate boundary zone in the western United States are processed. The VLBI data have been used to constrain the integrated rate of deformation across portions of the continental plate boundary in California and to provide a tectonic framework to interpret regional geodetic and geologic studies. Author

N89-15477# Consiglio Nazionale delle Ricerche, Frascati (Italy). Istituto di Fisica dello Spazio Interplanetario.
POLAR CUSP VERSUS BOUNDARY LAYER IN THE PRECIPITATING ELECTRON SIGNATURE
G. Mastrantonio, M. Candidi, and C.-I. Meng (Johns Hopkins Univ., Laurel, MD.) Dec. 1987 32 p Sponsored by CNR Piano Spaziale Nazionale, Italy Submitted for publication
(IFSI-87-17; ETN-89-93464) Avail: NTIS HC A03/MF A01

The DMSP satellite data was systematically surveyed during 3 months to determine the existence and frequency of occurrence of magnetospheric cusp regions with different plasma properties. The relationship of such observations with the orientation of the interplanetary magnetic field, with the solar wind parameters, and with geomagnetic activity was studied. Over 2000 cusp region crossings were analyzed. Only 2 percent of the cases show the precipitating electrons structured into 2 such distinct regions; they may be observed in either hemisphere. Such occurrences show a dependence on interplanetary magnetic field (IMF) orientations. The frequency of occurrence of the events also seems to depend on the values of solar wind parameters and IMF magnitude and reaches a maximum when quiet interplanetary conditions are met; it is also dependent on the aurora electrojet index. The energy levels of the two populations are always associated with different levels of flux. ESA

N89-15478# European Space Agency, Paris (France).
AEROSOL LIDAR FOR ENVIRONMENTAL PROTECTION AND METEOROLOGY
Christian Werner and Juergen Streicher (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, West Germany) Sep. 1988 162 p Transl. into ENGLISH of Aerosal-Lidar fuer Umweltschutz und Meteorologie (Oberpfaffenhofen, Fed. Republic of Germany, DFVLR), Jan. 1987 179 p Original language document was announced as N88-21828
(ESA-TT-1105; DFVLR-FB-87-43; ETN-89-93635) Avail: NTIS HC A08/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 50 Deutsche marks

The technical realization of different lidar systems is described with respect to applications in environment protection and meteorology. Specifications for lasers, detectors, and data systems are given. The problem of eye safety for practical applications is discussed. Examples of lidar for slant-range visibility detection and plume dispersion measurements are presented. ESA

N89-15479 California Univ., Davis.
A HYDROSTATIC, MESOSCALE, ATMOSPHERIC MODEL EMPLOYING IMPROVED PRESSURE GRADIENT, ADVECTION AND DIFFUSION CALCULATIONS Ph.D. Thesis
Saffet Tanrikulu 1988 214 p
Avail: Univ. Microfilms Order No. DA8814326

The error in the calculation of horizontal pressure gradients in hydrostatic atmospheric models has always been an unsolved problem. A two dimensional mesoscale model is constructed using terrain following coordinates to test 5 numerical techniques for computing the pressure gradient force. This model is based on primitive equations. Two methods were used to integrate the hydrostatic equation, one assuming constant potential temperature in a layer and one assuming constant lapse rate. Methods were also examined for evaluating the slope correction or pressure interpolation in terrain following coordinates. In two situations, one over a uniform slope and the other over a mountain, the proposed single downslope, constant gamma correction method does not generate any significant numerical error. The other four methods, including the three methods commonly in use, generate an error in the pressure acceleration. The stability of the mountain wave simulation was also examined along with properties of conservation of mass and energy of the model by using four numerical advection schemes. A vertical coordinate transformation was used for handling vertical diffusion when an expanding vertical grid spacing is employed. Dissert. Abstr.

N89-15480*# Colorado Univ., Boulder. Center for the Study of Earth from Space.
MINERALOGY AND COMPOSITION OF ARCHEAN CRUST, GREENLAND: A PILOT STUDY Final Report
Alexander F. H. Goetz and Brian Curtiss [1989] 13 p
(Grant NAGw-1183)
(NASA-CR-182859; NAS 1.26:182859) Avail: NTIS HC A03/MF A01 CSCL 08G

The Portable Instant Display and Analysis Spectrometer (PIDAS) was taken to southwestern Greenland to investigate in situ the potential application of AVIRIS to estimate the mineralogy and composition of rocks exposed in Archean terranes. The goal was to determine the feasibility of using a high spectral resolution scanner to find and study pristine rocks, those that have not been altered by subsequent deformation and metamorphism. The application of AVIRIS data to the problems in Greenland is logical. However, before a costly deployment of the U-2 aircraft to Greenland is proposed, this study was undertaken to acquire the spectral data necessary to verify that mineralogical mapping in the environmental conditions found there is possible. Although field conditions were far from favorable, all of the major objectives of the study were addressed. One of the major concerns was that lichens would obscure the rock surfaces. It was found that the spectral signature of the lichens was distinct from the underlying rocks. Thus, a spectrum of a rock outcrop, with its partial cover of lichens, can be un-mixed into rock and lichen components. The data acquired during the course of this study supports the conclusion that areas of pristine Archean crust can be differentiated from that which has experienced low grade alteration associated with Proterizoic faulting. Author

N89-15481# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
COMPARISON OF IONOSPHERIC ELECTRON TEMPERATURE ROCKET MEASUREMENTS OVER NATAL, BRAZIL, WITH IRI MODEL
I. J. Kantor, P. Muralikrishna, and M. A. Abdu Oct. 1988 18 p Presented at the 27th COSPAR, Espoo, Finland, 18-29 Jul. 1988
(Contract FINEP-537/CT)
(INPE-4722-PRE/1399) Avail: NTIS HC A03/MF A01

A SONDA III rocket was launched from Natal on December 11, 1985, at 21:30 LT, with a Langmuir probe that measured the kinetic electron temperature in the ionosphere. The rocket reached approximately 524 km giving information on the E and F regions of the equatorial ionosphere over Natal, Brazil. The electron temperature was determined through the derivative of the current versus voltage characteristics of the Langmuir probe and the detection of the space potential. Results are compared with the IRI model, and the divergence of the results with the model is discussed. Author

N89-15482*# Florida Atlantic Univ., Boca Raton.
PERIODIC BEHAVIORS IN THE OBSERVED VERTICAL COLUMN ABUNDANCES OF ATMOSPHERIC HYDROXYL Progress Report
Elizabeth Beaver Burnett, Clyde R. Burnett, and Kenneth R. Minschwaner 25 Jan. 1989 20 p
(Grants NAGw-989; NSF ATM-86-07193)
(NASA-CR-184667; NAS 1.26:184667) Avail: NTIS HC A03/MF A01 CSCL 04A

The data base for the vertical column abundance of atmospheric hydroxyl (OH) for Fritz Peak Observatory, Colorado (40 N, 105 W), now extends from 1976 through 1988 and is composed of 8849 independent data sets, averaging about 15 percent uncertainty and 20-minute time resolution each. The dominant solar zenith angle (chi) dependence of the OH abundance is

characterized by an empirical curve, N(88), which has been updated from N(82) to include all valid data from 1980 through 1988. The chi-dependence of the OH abundance has been, to a first order, removed from the data base by a normalization procedure in which each data point is divided by the N(88,AM) value for the corresponding solar zenith angle. The resulting normalized OH values may then be examined for other systematic effects, particularly for periodic variations. Observations have also been made at Boca Raton, Florida (26 N, 80 W) and at Truk, Federated States of Micronesia (7 N, 152 E). These data bases are much less extensive and, as such, are less amenable to analysis for periodic behaviors. Some comparisons with the Colorado data may be made, however. Author

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N89-15483 Purdue Univ., West Lafayette, IN.
NUMERICAL STUDY OF THE DIURNAL VARIATION OF THE DRYLINE Ph.D. Thesis
Ching-Chi Wu 1987 259 p
Avail: Univ. Microfilms Order No. DA8807689

The Purdue mesoscale model including atmospheric radiation and the surface energy budget is used to study the diurnal variation of the prognostic equation. The length scale (l) of Sun and Ogura (1980) and Deardorff (1980) is modified; the eddy coefficient is proportional to the square root of El, as suggested by Deardorff (1980); and the similarity equations proposed by Businger et al. (1971) are used in the surface layer. Two parts are included in this study. First, a simple one-dimensional ensemble average model is used to study the evoiution of the planetary boundary layer in both a cloud-free and cloudy atmosphere. The data of Wangara Day 33 are used to test the cloud-free case. The simulated results are in good agreement with both those observed and those produced by the other more complicated models. In the second part of this study, the Purdue mesoscale model is used to stimulate diurnal variation of the dryline during fair weather. The diurnal oscillation of the dryline is well simulated. The dryline moves eastward during the daytime, and westward during the night. The model also reproduces the observed strong nocturnal low-level jet along the sloping terrain. Sensitivity tests show that the horizontal soil moisture gradient, sloping terrain, and low-level vertical wind shear across the dryline play important roles in formation and maintenance of the strong moisture gradient along the dryline. Dissert. Abstr.

N89-15484*# Colorado Univ., Boulder. Cooperative Inst. for Research in Environmental Sciences.
CLOUD COVER DETERMINATION IN POLAR REGIONS FROM SATELLITE IMAGERY Semiannual Report
R. G. Barry, J. R. Key, and J. A. Maslanik 15 Dec. 1988 37 p
(Grant NAG5-898)
(NASA-CR-184567; NAS 1.26:184567) Avail: NTIS HC A03/MF A01 CSCL 04B

The principal objectives of this project are: (1) to develop suitable validation data sets to evaluate the effectiveness of the International Satellite Cloud Climatology Project (ISCCP) operational algorithm for cloud retrieval in polar regions and to validate model simulations of polar cloud cover; (2) to identify limitations of current procedures for varying atmospheric surface conditions, and to explore potential means to remedy them using textural classifiers; and (3) to compare synoptic cloud data from a control run experiment of the GISS climate model II with typical observed synoptic cloud patterns. Author

N89-15485*# Electro Magnetic Applications, Inc., Lakewood, CO.
APPLICATION OF TRIGGERED LIGHTNING NUMERICAL MODELS TO THE F106B AND EXTENSION TO OTHER AIRCRAFT
Poh H. Ng, Roger A. Dalke, Jim Horembala, Terence Rudolph, and Rodney A. Perala Washington NASA Dec. 1988 239 p
(Contract NAS1-17748)
(NASA-CR-4207; NAS 1.26:4207; EMA-88-R-1) Avail: NTIS HC A11/MF A01 CSCL 04B

The goal of the F106B Thunderstorm Research Program is to characterize the lightning environment for aircraft in flight. This report describes the application of numerical electromagnetic models to this problem. Topics include: (1) Extensive application of linear triggered lightning to F106B data; (2) Electrostatic analysis of F106B field mill data; (3) Application of subgrid modeling to F106B nose region, including both static and nonlinear models; (4) Extension of F106B results to other aircraft of varying sizes and shapes; and (5) Application of nonlinear model to interaction of F106B with lightning leader-return stroke event. Author

N89-15486# Massachusetts Inst. of Tech., Lexington. Lincoln Lab.
PRELIMINARY RESULTS OF THE 1983 COORDINATED AIRCRAFT - DOPPLER WEATHER RADAR TURBULENCE EXPERIMENT, VOLUME 1
Yean Lee, Albert R. Paradis, and Diane Klingle-Wilsom 26 Jul. 1988 75 p
(Contracts F19628-85-C-0002; DTFA01-80-Y-10546)
(AD-A197894; ATC-137-Vol-1; DOT/FAA/PM-86/11-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 04B

This report presents results of analyses of coordinated radar-aircraft data acquired from the 1983 experiment conducted at Hanscom AFB, Massachusetts. The objective of the experiment is to assess and validate the current NEXRAD algorithms for estimating aircraft turbulence from volume-scanned Doppler weather observations. Estimates of the turbulence severity index epsilon to the 1/3 power (a quantity used by NEXRAD) computed from radar and aircraft data are presented as a time series along each aircraft track. The radar point estimates of turbulence were averaged horizontally and vertically to yield layered Cartesian maps such as are intended for use by real time ATC controllers and pilots. The derived gust velocity (U sub de), also used to indicate the intensity of aircraft encountered turbulence, was computed so that comparisons could be made of the turbulence intensity scales inferred from values of epsilon and U sub de. These quantitative comparisons indicate that for the turbulence generally encountered during the flights, both radar and aircraft estimates of epsilon to the 1/3 power significantly overstate the severity of turbulence as reported by the aircraft pilot. The data analysis also shows that radar-based estimates of epsilon to the 1/3 power, often significantly exceeded aircraft based estimates of epsilon to the 1/3 power. In contrast, the quantity U sub e underestimates the aircraft reported turbulence intensity on all the flights. The uncertainty as to operational useful thresholds for radar upsilon 1/3, aircraft upsilon 1/3 and U sub de is discussed as is the use of spectrum width as a turbulence indicator. GRA

N89-15487# Naval Postgraduate School, Monterey, CA.
THREE-DIMENSIONAL ANALYSIS OF SYNOPTIC SATELLITE AND CONVENTIONAL METEOROLOGICAL OBSERVATIONS M.S. Thesis
Douglas D. Owen Mar. 1988 113 p
(AD-A199980) Avail: NTIS HC A06/MF A01 CSCL 04B

This thesis presents applications for three-dimensional displays of clouds and conventional meteorological observations. Several views of a well developed squall line over the Gulf of Mexico on 9 April 1984 are presented to demonstrate the effectiveness of an improved three dimensional displays process. The squall line is analyzed using enhanced GOES infrared imagery, space shuttle photography, and three dimensional cloud scenes to demonstrate the capability of the three dimensional software to highlight the vertical structure of clouds. Also, a procedure to incorporate displays of atmospheric thermodynamic variables into the three dimensional cloud displays has been developed. The surfaces added to the cloud displays include: constant height levels, constant pressure levels, and levels of constant potential temperature. These surfaces illustrate the usefulness of the display technique for the analyzing the three dimensional structure of the atmosphere.

Additionally, a technique has been developed to use lifting condensation levels as a first guess for the base heights of the clouds. Cloud bases determined from lifting condensation levels represent a more realistic approach of determining cloud base topography than the previous method of using a single flat base for all the clouds in the three dimensional display. Detailed appendices are included to demonstrate the software used and development in the this thesis. GRA

N89-15488# Washington Univ., Seattle. Dept. of Atmospheric Sciences.
PRELIMINARY EVALUATIONS OF THE USE OF A 35 GHz RADAR FOR MEASURING CLOUD BASE AND CLOUD TOP HEIGHTS Final Report, 1 Aug. 1986 - 31 Dec. 1987
Kumud R. Biswas and Peter V. Hobbs 6 Jun. 1988 89 p
(Contract F19628-86-C-0088)
(AD-A199133; AFGL-TR-88-0098) Avail: NTIS HC A05/MF A01 . CSCL 17I

To determine the accuracy with which a vertically-pointing 35 GHz radar can detect cloud base and cloud top heights, radar data of this type, collected in earlier research projects, have been compared to cloud heights derived from aircraft, a 5.5 GHz scanning radar, and radiosondes. Comparisons with in situ aircraft observations provide the most reliable means for evaluating the accuracy of the 35 GHz radar. In the absence of precipitation, or in very light precipitation, the heights of cloud bases and cloud tops detected by the 35 GHz radar were within approx 100 m of the heights measured by aircraft flying over the radar. However, very thin clouds were not detected by the radar unless they contained some ice particles. In light to heavy precipitation, the 35 GHz radar underestimated cloud top heights and often could not detect cloud bases. GRA

N89-15489# Creative Optics, Inc., Bedford, MA.
APPLICATION AND EVALUATION OF A DIFFERENTIAL INVERSION TECHNIQUE FOR REMOTE TEMPERATURE SENSING Final Report, Jul. 1986 - May 1988
Robert G. Hohlfeld, Ronald F. Wachtmann, and James C. Kilian 30 Jun. 1988 44 p
(Contract F19628-86-C-0167)
(AD-A199155; COI-SR-24; AFGL-TR-88-0138) Avail: NTIS HC A03/MF A01 CSCL 04B

A new theoretical approach is developed for remote temperature sensing based on Laplace transform techniques applied to the radiative transfer equation. This approach allows calculation of the atmospheric temperature profile based on measurements of the upwelling radiance and its derivatives. A detailed numerical study of this technique is carried out and the technique is applied to measurements of the upwelling radiance taken with a balloon-borne Fourier transform spectrometer (SCRIBE), and to data from the Tiros Operational Vertical Sounder (TOVS). Limitations of the technique arising from experimental errors, truncation errors, roundoff errors, and other causes are discussed. GRA

N89-15490# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
KINEMATIC AND DYNAMIC STUDIES OF MICROBURSTS IN THE SUBCLOUD LAYER DERIVED FROM JAWS DUAL-DOPPLER RADAR FOR A COLORADO THUNDERSTORM Ph.D. Thesis
John A. Coover, Jr. 1988 239 p
(AD-A199361; AFIT/CI/NR-88-187) Avail: NTIS HC A11/MF A01 CSCL 04B

The kinematic, dynamic and thermodynamic features of a simple and a complex microburst event are calculated, and comparisons made to find common and unique structural features that might lead to greater insight into the physical mechanisms responsible for microburst development. Dual-Doppler radar data were edited, gridded and kinematically integrated upward from the surface, to produce a 3-D wind field. The perturbation temperature and thermodynamic variables were used to compute the momentum budgets and field was derived from the buoyancy equation, using the derived wind and pressure fields. The results from this study reveal some basic similarities, along with some notable differences in structure. Both cases reveal a downward flux of mass, momentum, and eddying energy within the microburst; the boundary layer above 0.75 km is the source of the mass and momentum; an intermediate level near 0.75 km acts as a conduit for the downward flux; and the surface layer below 0.75 km that comprises the divergent flow enclosed in the microburst. The microburst also included a high reflectivity core at the center. The complex case contains a misocyclone above 0.75 km., which refers to the cyclonic circulation above the surface microburst. GRA

N89-15491# Naval Postgraduate School, Monterey, CA.
PERFORMANCE COMPARISONS FOR TWO VERSIONS OF THE STANIFORTH-MITCHELL BAROTROPIC NUMERICAL WEATHER PREDICTION CODE Interim Report, 1 Oct. - 31 Dec. 1987
R. E. Newton and A. L. Schoenstadt 26 Jul. 1988 8 p
(AD-A199374; NPS69-88-005) Avail: NTIS HC A02/MF A01 CSCL 04B

In a previous report, R. E. Newton proposed two improvements to the Staniforth-Mitchell barotropic numerical weather prediction code. Reported here are results of performance comparisons between the original code and an amended version which incorporates the two improvements: a new solution routine for the eigenproblems and a direct solution of the Helmholtz equation. It is found that the proposed improvements do reduce the computation time, but that the new eigenproblem algorithm results in excessive round-off error when single-precision arithmetic is used. GRA

N89-15492# Lawrence Livermore National Lab., CA.
CLIMATE CHANGE AND ITS INTERACTIONS WITH AIR CHEMISTRY: PERSPECTIVES AND RESEARCH NEEDS
J. E. Penner, P. S. Connell, Donald J. Wuebbles, and C. C. Covey Aug. 1988 92 p
(Contract W-7405-eng-48)
(DE89-001531; UCRL-21111) Avail: NTIS HC A05/MF A01

This paper attempts to outline and estimate the interactions between climate change and atmospheric chemistry that need investigation on both local and/or regional and global scales. The problem is not simply one of estimating temperature change and running chemical models we already possess to get an answer. The ways that a changing climate influences atmospheric chemistry include not only temperature and precipitation changes, but changes to atmospheric transport processes, changes to the budgets of species with biological sources (which respond to temperature and moisture changes), changes to vegetative cover which would alter deposition rates, changes in the rate of export of pollutants from the urban/regional environment to the global one, etc. Furthermore, changes in atmospheric chemical composition will lead to climate change. Figure 1.1 gives an overview of the climate/chemistry system and the interactions that it will be necessary to understand in order to predict the future state of our planet. The responses of these various subsystems may be highly coupled to both each other and the climate change itself. DOE

N89-15493*# District of Columbia Univ., Washington, DC.
STUDY OF THE CONSISTENCY OF CLIMATOLOGICAL PRODUCTS OF NIMBUS-7 Annual Report
Harbans L. Dhuria Dec. 1988 49 p
(Grant NAG5-1012)
(NASA-CR-181359; NAS 1.26:181359) Avail: NTIS HC A03/MF A01 CSCL 04B

The study, in addition to investigating the consistency of climatological products from Nimbus-7 Earth Radiation Budget and Temperature Humidity Infrared Radiometer experiments, focussed on the climatological analysis of the specified regions of the Earth. The climatological study consisted of the effects of various types of clouds on the net radiation, albedos, and emitted radiation. In addition to a correlational study for determining consistency level of data, a population study of the regions was formulated and

conducted. The regions under this study were formed by clustering the target areas using the criteria of climatological conditions such as geography, ocean, and land. Research is limited to tropics from 18 deg north to 18 deg south. A correlational study indicates that there is high positive correlation between high clouds and albedo, and a reduced negative correlation between albedo and net radiation. Author

N89-15494# European Space Agency, Paris (France).
CONCEPTION AND DISCUSSION OF A MODEL DESCRIBING ICE FORMATION ON VARIOUS OBSTACLES
Luc Brunet (Office National d'Etudes et de Recherches Aerospatiales, Paris, France) Sep. 1988 200 p Transl. into ENGLISH of Conception et Discussion d'un Modele de Formation du Givre sur des Obstacles Varies (Paris, France, ONERA) 1986 100 p Original language document was announced as N88-10460
(ESA-TT-1086; ONERA-NT-1986-6; ETN-89-93632) Avail: NTIS HC A09/MF A01

A development of the Bain-Lozowski ice formation model is presented. It takes into account the ice density in the local thickness of the deposit and investigates the aerodynamic and thermal aspects of the problem. The numerical model was tested in the wind tunnel. The validity is confirmed, showing the capability to predict the arrowhead ice forms commonly obtained for long exposure times. ESA

48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

N89-15495 Oregon State Univ., Corvallis.
OBSERVATIONS AND MODELLING OF FRONTS AND FRONTOGENESIS IN THE UPPER OCEAN Ph.D. Thesis
Roger M. Samelson 1987 101 p
Avail: Univ. Microfilms Order No. DA8806928

A thermistor chain was towed 1400 km through Eastern North Pacific Subtropical Frontal Zone in January 1980. The observations resolved surface layer temperature features with horizontal wavelengths between 200 m and several hundred kilometers and vertical scales of 10 to 70 m. The dominant features have horizontal wavelengths of 10 to 100 km, amplitudes of 0.2 to 1.0 C, and random orientation. Strong temperature fronts are observed near 33 N, 31 N and 27 N. There is evidence of vertically diffential horizontal advection by light winds in stable conditions and vertical mixing during high winds. Temperature at 15 m depth is roughly normally distributed around the climatological surface mean. Its horizontal gradient has high kurtosis. In the band 0.1 to 1 cpkm, the 15 m spectrum is inversely proportional to wavenumber, consistent with predictions from the theory of geostrophic turbulence, while the 70 m spectrum has additional variance consistent with Garrett-Munk internal wave displacements. We formulate analytically and solve numerically a semigeostrophic model for wind-driven thermocline upwelling. Dissert. Abstr.

N89-15496 Johns Hopkins Univ., Baltimore, MD.
A STUDY OF THE EQUATORIAL UNDERCURRENT Ph.D. Thesis
Ji-Jeng Yang 1987 91 p
Avail: Univ. Microfilms Order No. DA8807493

A simple model is developed to study the Equatorial Undercurrent. It is a time independent, two-layer fluid system in the ocean between two continents with a uniform wind blowing toward the west. Molecular friction and diffusion were neglected and made Broussinesq and the beta-earth approximations in this simple model. By physical reasoning and by comparing the order of magnitude of each term in the mean equations of momentum, the mean continuity equation and the mean buoyancy diffusion equation and using the observed data in the literature, it was first justified that all the nonlinear inertia terms, the Coriolis term, the pressure-gradient term, the horizontal diffusion term, and the vertical diffusion term are of the same order of magnitude in the x-equation of momentum. Then the y-equation of momentum was justified in geostropic balance and that the z-equation of momentum is hydrostatic. The results are in good agreement with the observed data in both the Pacific and the Atlantic. In addition, the theory permits comparison of observations in the Pacific and the Atlantic. Dissert. Abstr.

N89-15497 Oregon State Univ., Corvallis.
APPLICATIONS OF MARITIME DATA TO THE STUDY OF SURFACE FORCING OF SEASONAL AND INTERANNUAL OCEAN VARIABILITY IN EASTERN BOUNDARY REGIONS Ph.D. Thesis
Andrew Bakun 1987 239 p
Avail: Univ. Microfilms Order No. DA8806900

Maritime weather reports are used to define characteristic seasonal patterns of wind stress curl, on a smaller spatial scale than heretofore available, for the four major eastern boundary current systems of the world ocean. Interregional comparisons indicate that: (1) cyclonic wind stress curl overlies regions of eastern boundary counterflows (in conformity with certain theoretical models of these phenomena), (2) surface current patterns parallel wind stress curl contours (suggesting a control on the baroclinic structure of the upper ocean by the horizontal gradient of wind stress curl through differential vortex stretching), and (3) the predominant direction of rotation of oceanic eddies is the same as that of curl of the characteristic regional wind stress pattern. A lack of interregional consistency casts doubt on the hypothesis of local wind generation of tropical thermal domes. Maritime data-based time series of monthly indices of sea surface wind stress, wind stress curl, wind-mixing intensity, and ocean-atmosphere heat exchange are produced for 5-degree latitude/longitude quadrangles off the Iberian Peninsula. Use of analyzed meteorological fields as a basis for time series is explored. Dissert. Abstr.

N89-15498# SACLANT ASW Research Center, La Spezia (Italy).
ANALYSIS SYSTEMS FOR THE MESOSCALE THERMAL VARIABILITY IN THE GREENLAND-ICELAND-NORWEGIAN SEA
D. Grillaki-Steiert and V. Amoroso Jul. 1988 30 p
(AD-A199977; SACLANTCEN-SM-212) Avail: NTIS HC A03/MF A01 CSCL 08C

Mesoscale thermal structure and its spatial variability are very significant for acoustic propagation in the ocean. Therefore ocean thermal analysis procedures are important for the initialization and verification of environmental and acoustical models. This study involved the implementation of software, and the production, from irregularly-spaced data, of uniformly-gridded temperature fields for use by numerical acoustical and environmental models. The two analyses, considered for the production of temperature fields are: (1) an objective analysis method based on the Gauss-Markov Theorem which makes use of additional information such as climatology (the Levitus climatology has been used in this study), and (2) an interpolation method based on contouring techniques provided by the UNIRAS graphics package. Both methods agree well when there is a high density of data. When the data availability is limited, there is a danger that the objective analysis method can give rise to spurious gradients in going from the regime dominated by data to that dominated by climatology. Whether this is less desirable than a field based on extrapolation from a few observational data points depends on the application. GRA

N89-15499 Royal Netherlands Meteorological Inst., De Bilt. Afdeling Oceanografisch Onderzoek.
IMPLEMENTATION AND FIRST RESULTS OF THE NEDWAM MODEL, A THIRD GENERATION WAVE PREDICTION MODEL FOR THE NORTH SEA [IMPLEMENTATIE VAN EN EERSTE RESULTATEN MET HET NEDWAM MODEL, EEN DERDE GENERATIE GOLFVERWACHTINGSMODEL VOOR DE NOORDZEE]

B. Karssen Sep. 1987 45 p In DUTCH
(KNMI-TR-102; B8735068; ISSN-0169-1708; ETN-89-93578)
Copyright Avail: Royal Netherlands Meteorological Institute, P.O. Box 201, 3730 De Bilt, Wilhelminalaan 10, The Netherlands

The NEDWAM model, a third generation wave prediction model, is presented. The models of the third generation solve the energy transport equation for the two-dimensional wave spectrum by integration, for any spectral form. The behavior of NEDWAM is demonstrated for a simple case without energy gain or loss by the source function. The effect of the source function was examined in a test with simple geometry and wind field. The comparison of the NEDWAM results with wave measurements for a real storm in the North Sea show that the system works well. The calculation time is acceptable, in spite of the numerical and physical complexity of the model. ESA

51 LIFE SCIENCES (GENERAL)

N89-15500# Oregon State Univ., Corvallis. Dept. of Soil Science.
CTSPAC: MATHEMATICAL MODEL FOR COUPLED TRANSPORT OF WATER, SOLUTES AND HEAT IN THE SOIL-PLANT-ATMOSPHERE CONTINUUM. VOLUME 1: MATHEMATICAL THEORY AND TRANSPORT CONCEPTS
F. T. Lindstrom, D. E. Cawlfield, and L. Boersma Jul. 1988 150 p
(Grant EPA-R-814060)
(PB88-238316; EPA-600/3-88-030-Vol-1) Avail: NTIS HC A07/MF A01 CSCL 06C

The mathematical structure of the model consists of the coupling of the model for the transport through soils to a model for transport through plants. The coupled model describes uptake of water and solutes by plants from the soil solution. The rate of uptake is a function of the environmental conditions that determine the transpiration rate. Transport of water, solutes, and heat through the soil is modeled by a two-dimensional approach. The soil is divided into a series of depth increments. Initial root distribution is specified. Water and solutes are taken from each soil layer as determined by soil potential. Water transport in the plant is based on water potential and pressure gradients according to the Munch pressure flow hypothesis. Gradients are determined by water availability in the soil and by atmospheric conditions. Author

N89-15501*# Princeton Univ., NJ. Dept. of Psychology.
IONIC MECHANISMS SUBSERVING MECHANOSENSORY TRANSDUCTION AND NEURAL INTEGRATION IN STATOCYST HAIR CELLS OF HERMISSENDA Final Technical Report, 1 Jul. 1986 - 31 Jun. 1988
Joseph Farley 21 Nov. 1988 11 p
(Grant NAG2-397)
(NASA-CR-183393; NAS 1.26:183393) Avail: NTIS HC A03/MF A01 CSCL 06C

The neural processing of gravitational-produced sensory stimulation of statocyst hair cells in the nudibranch mollusk Hermissenda was studied. The goal in these studies was to understand how: gravireceptor neurons sense or transduce gravitational forces, gravitational stimulation is integrated so as to produce a graded receptor potential, and ultimately the generation of an action potential, and various neural adaptation phenomena which hair cells exhibit arise. The approach to these problems was primarily electrophysical. Author

N89-15502# Princeton Univ., NJ.
BIOREACTIVITY: STUDIES ON A SIMPLE BRAIN STEM REFLEX IN BEHAVING ANIMALS Annual Report, 1 Jun. 1987 - 31 May 1988
Barry L. Jacobs 22 Jul. 1988 6 p
(Grant AF-AFOSR-0301-87; AF Proj. 2312)
(AD-A199404; AFOSR-88-0696TR) Avail: NTIS HC A02/MF A01 CSCL 06D

A major problem in attempting to understand complex physiological processes, such as brain neuromodulation, or complex behavioral processes, such as arousal, is finding a simple system that will permit such analyses. The brain stem masseteric (jaw closure) reflex in cats is such a system. It is simple, containing only one synapse in brain, and receives dense inputs from two neurochemical systems important in neuromodulation and arousal. Initial pharmacologic studies showed that locally applied norepinephrine facilitated the reflex response. More importantly, physiologic conditions, known to activate the brain norepinephrine system, also facilitated the response. This latter finding was shown to be causal, rather than correlative, by a study which found that the facilitation could be blocked by prior destruction of the norepinephrine input specifically to the reflex circuitry. These data represent the first definitive example of an activational effect in an intact and behaving organism being attributable to a particular central neurotransmitter acting at a specific brain site. The masseteric reflex, is not simply a randomly chosen piece of behavior. Jaw closing (or clenching) is a well known response to stress and a component of the anxiety syndrome. Experimental evidence from studies in humans directly demonstrates that the masseteric reflex response is augmented by fear or anxiety. GRA

N89-15503# Naval Aerospace Medical Research Lab., Pensacola, FL.
HIGH PEAK POWER MICROWAVE PULSES AT 1.3 GHz: EFFECTS ON FIXED INTERVAL AND REACTION TIME PERFORMANCE IN RATS Interim Report, for Period Ending 1987
John A. DAndrea and Brenda L. Cobb Dec. 1987 19 p
(AD-A199489; NAMRL-1337) Avail: NTIS HC A03/MF A01 CSCL 06G

The current safety standards for radiofrequency and microwave exposure do not limit the peak power of microwave pulses for general or occupational exposures. To determine whether high peak power microwave pulses can alter known thresholds of behavioral disruption, four Long-Evans male rats were exposed to peak powers of 496.7, 336.7, and 146.7 kW in a waveguide exposure system while performing a time-related behavioral task. The task consisted of two components: a fixed interval schedule of reinforcement on one response lever and reaction time on a second lever. Responding on each lever was dependent on visual signals displayed through the translucent plastic levers. Trained rats performed the behavioral task during exposure to 1.3-GHz microwave pulses at a pulse repetition rate of 10 Hz. Significant changes occurred in behavioral performance. Session time increased, response rates decreased, and reaction times significantly increased at whole-body SARs of 6.3 and 10.5 W/kg. The alteration of behavior in this study occurred at a whole body SAR between 3.5 and 6.3 W/kg, which is consistent with previous estimates of 4 W/kg as the threshold for behavioral alteration. The high peak power pulses used in this study did not alter this threshold, suggesting that the primary effect must be tissue heating. GRA

N89-15504# Naval Health Research Center, San Diego, CA.
PLATEAU IN MUSCLE BLOOD FLOW DURING PROLONGED EXERCISE IN MINIATURE SWINE Interim Report
M. D. McKirnan, Charles G. Gray, and Francis C. White 25 Aug. 1988 25 p
(AD-A199547; NHRC-88-32) Avail: NTIS HC A03/MF A01 CSCL 06J

Cardiovascular, metabolic and thermoregulatory responses were studied in eight male miniature swine during a prolonged treadmill run. Each animal underwent 8 to 10 weeks of exercise regimen enabled the animals to run at 65 percent of the heart rate range for approximately 100 minutes. Skin wetting and a fan were used to cool the pigs during the run. Regional blood flow was significantly altered with the onset of exercise; however, hindlimb muscle and total gastrointestinal blood flow were unchanged throughout the exercise period. Compared with five minute values, heart rate and cardiac output were significantly

elevated. Core temperatures increased between 5 and 30 minutes of exercise but then remained unchanged to the end of exercise. Mean arterial pressure oxygen consumption and blood lactate did not change during the exercise bout. These data indicate that limiting increases in core temperature during prolonged exercise was associated with a plateau in active muscle blood flow. The cardiovascular drift observed after the plateau in core temperature probably reflected an increased skin blood flow since cooling procedures effectively limited the thermal stress during prolonged exercise. GRA

N89-15505*# Alabama Univ., Huntsville. Consortium for the Space Life Sciences.
ENVIRONMENTAL CONTROL MEDICAL SUPPORT TEAM Final Report
William J. Crump and Melvin V. Kilgore, Jr. Oct. 1988 430 p (Grant NAG8-698)
(NASA-CR-184619; NAS 1.26:184619; UAH-RR-742) Avail: NTIS HC A19/MF A01 CSCL 06C

The activities conducted in support of the Environmental Control and Life Support Team during December 7, 1987 through September 30, 1988 are summarized. The majority of the ongoing support has focused on the ECLSS area. Through a series of initial meetings with the ECLSS team and technical literature review, an initial list of critical topics was developed. Subtasks were then identified or additional related tasks received as action items from the ECLSS group meetings. Although most of the efforts focused on providing MSFC personnel with information regarding specific questions and problems related to ECLSS issues, other efforts regarding identifying an ECLSS Medical Support Team and constructing data bases of technical information were also initiated and completed. The specific tasks are as follows: (1) Provide support to the mechanical design and integration of test systems as related to microbiological concerns; (2) Assist with design of Human Subjects Test Protocols; (3) Interpretation and recommendations pertaining to air/water quality requirements; (4) Assist in determining the design specifications required as related to the Technical Demonstration Program; (5) Develop a data base of all microorganisms recovered from previous subsystem testing; (6) Estimates of health risk of individual microbes to test subjects; (7) Assist with setting limits for safety of test subjects; (8) Health monitoring of test subjects; (9) Assist in the preparation of test plans; (10) Assist in the development of a QA/QC program to assure the validity, accuracy and precision of the analyses; and (11) Assist in developing test plans required for future man in the loop testing. Author

N89-15506*# Lockheed Engineering and Sciences Co., Washington, DC.
USSR SPACE LIFE SCIENCES DIGEST, ISSUE 20
Lydia Razran Hooke, ed., P. Lynn Donaldson, ed., Ronald Teeter, ed., Victoria Garshnek, ed., and Joseph Rowe, ed. (Library of Congress, Washington, DC.) Washington NASA Dec. 1988 127 p
(Contract NASw-4292)
(NASA-CR-3922(23); NAS 1.26:3922(23)) Avail: NTIS HC A07/MF A01 CSCL 06C

Abstracts of research in the areas of biological rhythms, body fluids, botany, endrocrinology, enzymology, exobiology, genetics, human performance, immunology, life support systems, mathematical modeling, and numerous other topics related to space and life sciences are given. R.J.F.

N89-15507# National Academy of Sciences - National Research Council, Washington, DC. Task Group on Life Sciences.
SPACE SCIENCE IN THE TWENTY-FIRST CENTURY: IMPERATIVES FOR THE DECADES 1995 TO 2015. LIFE SCIENCES
1988 155 p
(LC-87-43334; ISBN-0-309-03880-4) Avail: NTIS HC A08/MF A01

The status and goals of the five areas of research (exobiology, global biology, controlled ecological life support systems, space biology, and space medicine) are discussed. Also discussed are the instrumentation and technologies required to achieve these goals. Author

N89-15131# Ruhr Univ., Bochum (Germany, F.R.). Arbeitsgruppe fuer Verletchende Endokrinologie.
INVESTIGATIONS OF THE SURVEY OF THE REPRODUCTIVE BIOLOGY OF XIPHOPHORUS IN AN AQUARACK
Volker Bluem and Ruediger Schulz *In* ESA, Aquarack: Aim and Possible Research Projects Oct. 1988 p 17-25 Transl. into ENGLISH from Das Aquarack. Rahmendisposition und Moegliche Wissenschaftliche Projekte (Cologne, Fed. Republic of Germany, DFVLR), 1987 p 19-27 Original language document was announced as N88-10471 (For primary document see N89-15129 07-12)
Avail: NTIS HC A05/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 33.50 Deutsche marks

N89-15134# Stuttgart Univ. (Germany, F.R.). Inst. fuer Zoologie.
FUNCTIONAL PLASTICITY OF THE NERVOUS SYSTEM OF VERTEBRATES
Hinrich Rahmann and Wolfgang Probst *In* ESA, Aquarack: Aim and Possible Research Projects Oct. 1988 p 43-55 Transl. into ENGLISH from Das Aquarack. Rahmendisposition und Moegliche Wissenschaftliche Projekte (Cologne, Fed. Republic of Germany, DFVLR), 1987 p 47-59 Original language document was announced as N88-10474 (For primary document see N89-15129 07-12)
Avail: NTIS HC A05/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 33.50 Deutsche marks

N89-15135# Hamburg Univ. (Germany, F.R.). Inst. fuer Zoologie.
THE INFLUENCE OF WEIGHTLESSNESS ON THE METABOLISM IN BIOMPHALARIA GLABRATA
Wilhelm Becker *In* ESA, Aquarack: Aim and Possible Research Projects Oct. 1988 p 56-65 Transl. into ENGLISH from Das Aquarack. Rahmendisposition und Moegliche Wissenschaftliche Projekte (Cologne, Fed. Republic of Germany, DFVLR), 1987 p 61-68 Original language document was announced as N88-10475 (For primary document see N89-15129 07-12)
Avail: NTIS HC A05/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 33.50 Deutsche marks

N89-15136# Bonn Univ. (Germany, F.R.). Inst. fuer Botanie.
THE USEFULNESS OF MICROALGAL STRUCTURES AS AN ELEMENT OF CLOSED ECOLOGICAL SYSTEMS LIKE AQUARACK AND CELSS
Karlheinz Kreuzberg *In* ESA, Aquarack: Aim and Possible Research Projects Oct. 1988 p 66-74 Transl. into ENGLISH from Das Aquarack. Rahmendisposition und Moegliche Wissenschaftliche Projekte (Cologne, Fed. Republic of Germany, DFVLR), 1987 p 69-76 Original language document was announced as N88-10476 (For primary document see N89-15129 07-12)
Avail: NTIS HC A05/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 33.50 Deutsche marks

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

N89-15508*# George Washington Univ., Washington, DC. Science Communication Studies.
SPACE MEDICINE RESEARCH PUBLICATIONS: 1984-1986
Janice S. Wallace Washington, DC Oct. 1988 120 p

(Contract NASw-4324)
(NASA-CR-4184; NAS 1.26:4184) Avail: NTIS HC A06/MF A01 CSCL 06E

A list is given of the publications of investigators supported by the Biomedical Research and Clinical Medicine Programs of the Space Medicine and Biology Branch, Life Sciences Division, Office of Space Science and Applications. It includes publications entered into the Life Sciences Bibliographic Database by the George Washington University as of December 31, 1986. Publications are organized into the following subject areas: Clinical Medicine, Space Human Factors, Musculoskeletal, Radiation and Environmental Health, Regulatory Physiology, Neuroscience, and Cardiopulmonary. Author

N89-15509# Harvard Univ., Cambridge, MA.
CONTEXT EFFECTS IN RECOGNIZING SYLLABLE-FINAL Z AND S IN DIFFERENT PHRASAL POSITIONS Annual Report No. 1, 15 Jun. 1987 - 15 Jun. 1988
Peter C. Gordon 6 Sep. 1988 37 p
(Grant AF-AFOSR-0305-87; AF Proj. 2313)
(AD-A199923; AFOSR-88-0936TR) Avail: NTIS HC A03/MF A01 CSCL 05H

Two experiments are reported that use gating methods to examine the role of non-semantic aspects of sentential context in the recognition of phonetic segments. Performance in recognizing syllable-final s and z improves when the syllables are presented to listeners in sentential context as compared to when they are presented in isolation. It appears that listeners are able to use sentential information in order to factor out prosodically based variations in the temporal characteristics of speech in order to more accurately interpret durational cues to segment identity. These findings extend previous results on rate-dependent processing of overall speaking rate to the processing of local speaking rate, and they provide further demonstration of the importance of extended phonetic context in speech recognition. GRA

N89-15510# Air Force Systems Command, Wright-Patterson AFB, OH. Foreign Technology Div.
PEOPLE'S REPUBLIC OF CHINA NATIONAL STANDARD LASER RADIATION OCCUPATIONAL HEALTH STANDARD
5 Oct. 1988 29 p Transl. into ENGLISH of Laser Radiation Occupational Health Standard (People's Republic of China), 1985 6 p
(AD-A199948; FTD-ID(RS)T-0603-88) Avail: NTIS HC A03/MF A01 CSCL 09C

As far as the long term exposure to laser radiation of a certain strength by laser workers is concerned, it is possible for it to give rise to reductions in visual acuity, clouding of lenses, as well as headaches, anemia, nerve weakness, and other similar bad effects throughout the entire body. The potentially problem causing laser radiations are capable of leading to severe acute disorders. Because of this, personnel in contact with lasers (exclusive of those receiving laser diagnosis and treatment) should receiver strengths of radiation which are definitely limited. The wavelengths of laser radiation are from 200 m to 1 mm. The maximum permissible amounts of radiation (or degree of radiation) are not only related to wavelength, but also, have a close relationship with the duration of the radiation received. GRA

N89-15511# Dayton Univ., OH.
MODELING EYE MOVEMENT SEQUENCES USING CONCEPTUAL CLUSTERING TECHNIQUES Final Report, Oct. 1985 - Dec. 1987
Michael S. Belofsky and Don R. Lyon Aug. 1988 16 p
(Contracts F33615-84-C-0066; F33615-87-C-0012)
(AD-A199403; AFHRL-TR-88-16) Avail: NTIS HC A03/MF A01 CSCL 12I

An algorithm for clustering noisy continuous numeric data was developed in a learning system called 2DCG (two dimensional cluster generalization). The 2DCG system operates in a two-dimensional space, but a general system could operate in an N-dimensional space. The objective of the system was to learn a set of rules which modeled human observers (in the application presented here, this model predicted changes in the eye position of human observers during a visual monitoring task). The rule set had to be complete, consistent, and nonredundant, while minimizing the number and maximizing the generality of the rules. The development of this model and its performance in accounting for noisy data are described. GRA

N89-15512# Naval Aerospace Medical Research Lab., Pensacola, FL.
THE DEVELOPMENT OF PERFORMANCE-BASED AUDITORY AVIATION CLASSIFICATION STANDARDS IN THE US NAVY
Gerald B. Thomas, Carl E. Williams, and Jill F. Raney Dec. 1987 31 p
(AD-A199488; NAMRL-1335) Avail: NTIS HC A03/MF A01 CSCL 06D

A series of studies was undertaken to develop a performance-based test battery to ascertain the auditory fitness of naval aviators. On the basis of literature reviews, interviews with experienced pilots, and published job analyses, several auditory abilities were identified. These included perception of degraded speech, response time to auditory signals, auditory short-term memory, and auditory selective attention. Tests to measure these abilities were developed and evaluated in terms of sensitivity and test-retest reliability (Experiments 1 and 2; total N = 105). Sensitivity was sufficient to readily discriminate between pilots of disparate age groups, and test-retest reliabilities ranged from .71 to .88 for individual test battery elements. Experiment 3 sought to increase the validity of the test battery by incorporating major elements into a tape-recorded flight scenario. GRA

N89-15513*# Good Samaritan Hospital and Medical Center, Portland, OR. Dept. of Neuro-otology.
ROLE OF ORIENTATION REFERENCE SELECTION IN MOTION SICKNESS Semiannual Status Report
Robert J. Peterka and F. Owen Black Dec. 1988 82 p
(Grant NAG9-117)
(NASA-CR-184609; NAS 1.26:184609) Avail: NTIS HC A05/MF A01 CSCL 06E

Previous experiments with moving platform posturography have shown that different people have varying abilities to resolve conflicts among vestibular, visual, and proprioceptive sensory signals used to control upright posture. In particular, there is one class of subjects with a vestibular disorder known as benign paroxysmal positional vertigo (BPPV) who often are particularly sensitive to inaccurate visual information. That is, they will use visual sensory information for the control of their posture even when that visual information is inaccurate and is in conflict with accurate proprioceptive and vestibular sensory signals. BPPV has been associated with disorders of both posterior semicircular canal function and possibly otolith function. The present proposal hopes to take advantage of the similarities between the space motion sickness problem and the sensory orientation reference selection problems associated with the BPPV syndrome. These similarities include both etiology related to abnormal vertical canal-otolith function, and motion sickness initiating events provoked by pitch and roll head movements. The objectives of this proposal are to explore and quantify the orientation reference selection abilities of subjects and the relation of this selection to motion sickness in humans. Author

N89-15514# Oak Ridge National Lab., TN. Biology Div.
RADIATION PROTECTION GUIDELINES FOR SPACE MISSIONS
R. J. M. Fry 1987 16 p Presented at the NATO Advanced Study Institute on Terrestrial Space Radiation and Its Biological Effects, Corfu, Greece, 12 Oct. 1987
(Contract DE-AC05-84OR-21400)
(DE88-006181; CONF-8710285-1) Avail: NTIS HC A03/MF A01

The original recommendations for radiation protection guidelines were made by the National Academy of Sciences in 1970. Since that time the U.S. crews have become more diverse in their makeup and much has been learned about both radiation-induced cancer

and other late effects. While far from adequate there is now some understanding of the risks that high-Z and -energy (HZE) particles pose. For these reasons it was time to reconsider the radiation protection guidelines for space workers. This task was undertaken recently by National Council on Radiation Protection (NCRP). DOE

N89-15515# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.). Abteilung Weltraumbiologie.
COMPARATIVE INVESTIGATIONS CONCERNING GRAVITAXIS AND MORPHOLOGY OF LOXODES AND PARAMECIUM Thesis - Bonn Univ.
Ruth Hemmersbach-Krause Aug. 1988 159 p In GERMAN; ENGLISH summary
(DFVLR-FB-88-27; ISSN-0171-1342; ETN-89-93657) Avail: NTIS HC A08/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 55 Deutsche marks

The behavior of free-swimming animal cells was observed after a 180 deg turn of the gravity vector and during 0-g simulation (fast-running clinostat). If there is no polar stimulus other than gravity, Loxodes shows a positive, Paramecium a negative gravitaxis. The results support the hypothesis that graviperception is an active physiological process. The cytoskeleton of Loxodes was investigated under 1-g conditions. While the microtubules can be shown by electron microscopy and immunofluorescence, the existence of actin in Loxodes is still in dispute. ESA

N89-15516*# Cornell Univ., White Plains, NY. Inst. of Chronobiology.
EFFECTIVENESS OF CIRCADIAN COUNTERMEASURES IN SIMULATED TRANSMERIDIAN FLIGHT SCHEDULES Final Technical Report
Margaret L. Moline and Timothy H. Monk [1989] 24 p
(Contract NCC2-253)
(NASA-CR-184640; NAS 1.26:184640) Avail: NTIS HC A03/MF A01 CSCL 06P

The symptoms of jet-lag commonly afflict travelers who cross time zones. Insomnia during the new night, daytime fatigue, malaise, sleepiness, and gastrointestinal disturbances can occur for as long as 3 weeks after jet travel across even a few time zones. These symptoms are largely due to the slow rate of adjustment of the internal circadian timing system to the new time zone. Since business (or pleasure) can be seriously interrupted by such symptoms, it is important to determine ways to speed up the adjustment process to ameliorate the symptoms. Airline pilots have reported that they frequently nap to counter jet lag symptoms, and that they view this as a useful technique. Napping as a countermeasure would be attractive since it is practical and would take advantage of a naturally occurring phase of sleepiness after lunch. Napping also makes sense since insomnia is a common jet lag symptom. Thus, a laboratory simulation of jet lag was designed to test the ability of napping to increase the rate of adjustment following a time zone shift in a population of middle-aged men. Author

N89-15517*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
SPACELAB 3 FLIGHT EXPERIMENT NO. 3AFT23: AUTOGENIC-FEEDBACK TRAINING AS A PREVENTIVE METHOD FOR SPACE ADAPTATION SYNDROME
Patricia S. Cowings, William B. Toscano, Joe Kamiya, Neal E. Miller (Yale Univ., New Haven, CT.), and Joseph C. Sharp Oct. 1988 115 p
(NASA-TM-89412; A-87034; NAS 1.15:89412) Avail: NTIS HC A06/MF A01 CSCL 06S

Space adaptation syndrome is a motion sickness-like disorder which affects up to 50 percent of all people exposed to microgravity in space. This experiment tested a physiological conditioning procedure (Autogenic-Feedback Training, AFT) as an alternative to pharmacological management. Four astronauts participated as subjects in this experiment. Crewmembers A and B served as treatment subjects. Both received preflight training for control of heart rate, respiration rate, peripheral blood volume, and skin conductance. Crewmembers C and D served as controls (i.e., did not receive training). Crewmember A showed reliable control of his own physiological responses, and a significant increase in motion sickness tolerance after training. Crewmember B, however, demonstrated much less control and only a moderate increase in motion sickness tolerance was observed after training. The inflight symptom reports and physiological data recordings revealed that Crewmember A did not experience any severe symptom episodes during the mission, while Crewmember B reported one severe symptom episode. Both control group subjects, C and D (who took antimotion sickness medication), reported multiple symptom episodes on mission day 0. Both inflight data and crew reports indicate that AFT may be an effective countermeasure. Additional data must be obtained inflight (a total of eight treatment and eight control subjects) before final evaluation of this treatment can be made. Author

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N89-15518# California Univ., Santa Barbara. Graduate School of Education.
INDIVIDUAL DIFFERENCES IN SKILL ACQUISITION: INFORMATION PROCESSING EFFICIENCY AND THE DEVELOPMENT OF AUTOMATICITY Final Technical Paper, Apr. 1983 - Mar. 1986
James W. Pellegrino Jul. 1988 153 p
(Contract F41689-83-C-0017)
(AD-A198310; AFHRL-TR-87-52) Avail: NTIS HC A08/MF A01 CSCL 05H

Results are reported for a series of 13 studies examining individual differences in information processing efficiency. The tasks used represented different content domains and levels of processing complexity. Measures of information processing speed showed little relationship to each other and/or standardized ability measures. The results are considered relative to issues of assessing: (1) an individual's current levels of information processing efficiency, and (2) movement toward more automatic or efficient processing levels. Assessment of the latter is problematic and may require complex tasks performed over intervals of time longer than 2 to 5 hours. Finally, standardized ability measures only partially reflect an individual's current levels of processing efficiency. GRA

N89-15519# Paris V Univ. (France). Psychologie Experimental.
TIME PERCEPTION AND EVOKED POTENTIALS Final Research Note, Sep. 1981 - Sep. 1983
Paul Fraisse Jul. 1988 50 p
(Contract DAJA37-81-C-0211; DA Proj. 2Q1-61102-B-74-F)
(AD-A198616; ARI-RN-88-69) Avail: NTIS HC A03/MF A01 CSCL 05H

In this research note, time perception is studied from a psychophysical and electrophysiological point of view, during durations reproduction experiments. No relation was found between the auditory evoked potential (AEP) amplitude and durations reproduction errors. The AEP amplitude is influenced, however, by the interval between the clicks and the repetition of the stimulations. The results of the durations reproduction task show an over-estimation of the shorter intervals and an under-estimation of the longer ones. GRA

N89-15520# California Univ., Los Angeles. Visual Psychophysics Lab.
DEVELOPMENT OF A CHROMATIC/LUMINANCE CONTRAST SCALE Interim Report
Lynn A. Olzak, James P. Thomas, and Harold Stanislaw Dec. 1987 126 p

(Grant DTCG39-C-86-80205)
(AD-A198628; USCG-D-12-88; CGR/DC-19/87) Avail: NTIS HC A07/MF A01 CSCL 06D

A model was developed to predict the detectability of small low-contrast targets viewed against a uniform background in daylight conditions. The model quantitatively describes the interrelationships among detectability, target size, target luminance, target chromaticity, background chromaticity, and background luminance. A theoretical approach was used to develop a general form of the predictive model. Two empirical studies were performed to estimate parameters of the model, and a final study was performed to validate the model. The final model is presented in two forms, both easily used in field situations. The first predicts detectability of a specified target (size, luminance and chromaticity) when viewed against a specified background (luminance and chromaticity). The second predicts the distance at which such a target will be detected. A guide to the use of the model is included. GRA

N89-15521# Texas Christian Univ., Fort Worth. Dept. of Psychology.
STRATEGY-BASED TECHNICAL INSTRUCTION: DEVELOPMENT AND EVALUATION Final Report, Sep. 1984 - Jun. 1988
Donald F. Dansereau Aug. 1988 196 p Sponsored by ARI, Alexandria, VA
(AD-A199903; Rept-0002AB; ARI-RN-88-82) Avail: NTIS HC A09/MF A01 CSCL 05H

This research note discusses scripted peer cooperation, an economical and effective technique for improving the acquisition of technical knowledge and skills. Experiences with scripted cooperation have also been shown to facilitate transfer to individual learning situations and to unscripted groups. At a more specific level, the research behind this note has identified parameters relevant to the assignment of participants to dyads based on pre-measured characteristics, to the selection of scripts dependent on target tasks and the outcomes desired, and to the use of node-link knowledge maps as communications props. In addition, we have used our detailed analyses of cooperative interactions to develop models of task-oriented group processing. This research program has thus provided a basis for the development of an information processing model of cooperative learning, and our detailed analysis of this approach has been a first step in providing a conceptual framework for this powerful educational technique. GRA

N89-15522# Naval Ocean Systems Center, San Diego, CA.
TEMPORAL KNOWLEDGE: RECOGNITION AND LEARNING OF TIME-BASED PATTERNS Final Report
Carey E. Priebe, David J. Marchette, and Chen-Han Sung Aug. 1988 17 p
(AD-A199911; NOSC/TD-1334) Avail: NTIS HC A03/MF A01 CSCL 12I

A self-organizing, distributed, massively parallel network anatomy for the recognition of input stimuli and the learning of temporal patterns is proposed. The network adapts itself to recognize individual incoming events in the first, or static, subsystem. These recognized events, received by the system over time, are simultaneously categorized as specific sequences by the temporal subsystem. Separate attentional mechanisms allow for the recognition of events with a low signal-to-noise ratio while simultaneously allowing attention in the temporal subsystem to be focused only on sequences that meet some minimum length criterion. The static subsystem is based on the adaptive resonance paradigm of S. Grossberg. The temporal subsystem, a Gaussian classifier, processes the static information produced by the first subsystem. These Gaussian classifications represent the statistics of the temporal data and use a scheme of moving mean and moving covariance to update the classes. Via supervised learning these self-developed classes are then combined into an overall probability estimate using a bayesian probability scheme. GRA

N89-15523# Air Force Human Resources Lab., Brooks AFB, TX.
PERSONALITY, ATTITUDES, AND PILOT TRAINING PERFORMANCE: FINAL ANALYSIS Interim Report, Sep. 1983 - Dec. 1987
Frederick M. Siem and Thomas R. Carretta Oct. 1988 32 p
(AD-A199983; AFHRL-TP-88-23) Avail: NTIS HC A03/MF A01 CSCL 05H

Developments in research concerning personality characteristics have led to a renewed interest in applications of individual differences measures for selection of pilot candidates. Recent research efforts have focused on selecting for positive characteristics, rather than screening out pathological traits. Another development is the use of tests in which the dimension of interest is not readily apparent to the test taker. In the present investigation, five personality and attitudinal tests were administered to United States Air Force (USAF) pilot candidates as part of an experimental test battery under consideration for operational use in pilot selection and classification, the Basic Attributes Tests (BAT) System. These tests were designed to assess decisiveness, risk-taking, self-confidence, survival attitudes, and field dependence-independence. Scores from these tests were examined for their utility in predicting final training outcome (graduation or elimination) and a follow-on training assignment (fighter or non-fighter aircraft). Results indicated that as a group the tests demonstrated weak relationships with the performance criteria. No test was valid against both performance outcomes. Measures from all five tests were combined into a model that also included scores from the Air Force Officer Qualifying Test (AFOQT), the paper-and-pencil examination currently used for USAF pilot selection. GRA

N89-15524# Rutgers - The State Univ., New Brunswick, NJ. Dept. of Psychology.
EYE MOVEMENTS AND VISUAL INFORMATION PROCESSING Final Progress Report, Jan. 1985 - Mar. 1988
Eileen Kowler 2 Aug. 1988 7 p
(Grant AF-AFOSR-0022-85; AF Proj. 2313)
(AD-A200006; AFOSR-88-1139TR) Avail: NTIS HC A02/MF A01 CSCL 06D

Eye movements are needed to acquire visual information because clear vision is available only at the center of the retina. The main objectives of the research are to understand that cognitive and sensory factors underlying the control of eye movements, and to understand how visual processing depends on the eye movements used to inspect displays. Experiments were completed shows that: (1) smooth pursuit becomes poor when the frequency of target motion exceeds 0.5 Hz even when the amplitude of motion is small (less than 30') so that average target velocity is low (Martins et al., 1985f); (2) the acquisition of information from visual displays is not limited by the directional pattern of saccades but is limited by size: small (less than 30') saccades, required to inspect small details not forming recognizable visual patterns, cannot be controlled accurately without latencies of several hundred milliseconds. GRA

N89-15525# Missouri Univ., Columbia. Dept. of Statistics.
CALIBRATION OF TEST ITEM AND MEASUREMENT OF ABILITIES Final Report, 1 Jan. 1985 - 30 Sep. 1988
Robert K. Tsutakawa Sep. 1988 17 p
(Contract N00014-85-K-0113; RR04204)
(AD-A199435) Avail: NTIS HC A03/MF A01 CSCL 12C

The overall goal of this project is to develop new Bayesian procedures for mental testing. A typical test, which is studied here, consists of k test items administered to n examinees. The data consists of an nxk matrix of binary responses indicating which of the k items are scored correctly and which incorrectly by each of the n examinees. The statistical procedures are based on the assumption that there is a model which specifies the probability of a correct response to each item as a function of an unidimensional ability. Such functions are assumed to belong to certain families such as, the two-parameter logistic (2PL) or three-parameter (3PL) curves. These curves are identified by

parameters called item parameters. When these models are used for testing, a set of items is initially calibrated using a moderately large value for n (the sample size). The calibration consists of estimating the item parameters. The calibrated curves are then used to score abilities of new examinees. GRA

N89-15526# Naval Aerospace Medical Research Lab., Pensacola, FL.
DEVELOPMENT AND EVALUATION OF AN AUTOMATED SERIES OF SINGLE-AND MULTIPLE-DICHOTIC LISTENING AND PSYCHOMOTOR TASKS Interim Report, for Period Ending 1987
Glenn R. Griffin and Peter D. Collyer Dec. 1987 18 p
(AD-A199490; NAMRL-1336) Avail: NTIS HC A03/MF A01 CSCL 05H

Attrition in undergraduate naval aviation training is costly. An average of 25 percent of student naval aviators fails to complete training. This study reports an effort to develop automated single- and multiple-dichotic listening and psychomotor tasks, which have the potential to reduce aviator attrition through improved selection and may also be useful in initial pipeline classification. Statistical analysis of Study 1, comparing a forward and backward series of automated dichotic listening (DLT) and psychomotor (PMT) tasks, indicated that a backward-direction orientation associated with the psychomotor tests resulted in increased difficulty for all PMT measures and two of three multitask DLT measures. The correlational estimates of test-retest reliability for the multitask DLT and PMT measures were adequate for both series of automated tasks but slightly higher ($r = .80$ DLT, $r = .90$ PMT) for the backward series. The relation between such seemingly different tasks is difficult to understand since the DLT is an auditory cognitive processing task, and the PMT is an eye, hand, foot coordination task. However, the significant correlations were both smaller and fewer in number for the backward series of automated tests. Study 2 was a correlational evaluation between the new automated multitask measures and old nonautomated tasks with demonstrated validity for the prediction of primary flight performance. The results of Study 3 indicated that certain automated DLT and PMT measures were significantly related to primary flight grades (PFG) in Navy flight training. GRA

N89-15527# Naval Aerospace Medical Research Lab., Pensacola, FL.
SOME CONSIDERATIONS IN THE DESIGN OF A COMPUTERIZED HUMAN INFORMATION PROCESSING BATTERY Final Report, Aug. 1985 - Feb. 1986
Diane L. Damos Dec. 1987 56 p
(AD-A199491; NAMRL-MONOGRAPH-35) Avail: NTIS HC A04/MF A01 CSCL 05H

A test battery is nothing more than a set of tests that, as a whole, measure certain skills, abilities, and processes. This report discusses general issues and problems associated with the development of computerized human information processing test batteries. It is concerned primarily with batteries that will be administered in a repeated-measures paradigm although some of the information pertains to the construction of any battery. Among the issues discussed in the report are task selection, task ordering, the use of pacing, and hardware and software implementation problems. Implementation problems associated with specific information processing tasks--such as mental arithmetic tasks and vigilance tasks--are also described. This report is intended for individuals who have a limited knowledge of human information processing and the pitfalls associated with computer-based testing. GRA

N89-15528# Army Natick Research and Development Command, MA.
PSYCHOSOCIAL ACCOMMODATION TO GROUP CONFINEMENT IN THE ADVANCED BASE HABITAT Final Technical Report, Oct. 1986 - Jun. 1988
Philip H. Warren 1 Jun. 1988 35 p
(AD-A199588; NATICK/TR-88/063) Avail: NTIS HC A03/MF A01 CSCL 05H

There are many military situations in which small groups of individuals must live and function in confining environments for extended periods of time. The U.S. Air Force, through its contractor Hamilton Standard, has developed a model for an Advanced Base Habitat for long-term living underground. Initial manned tests of a prototype of this Advanced Base focused on engineering and life-support issues. However, having personnel living in the Habitat during the tests provided an opportunity to assess the psychological effects of the Habitat. Three tests were conducted with four crew members each; two tests of four days each, and one of seven days. Following each of the tests an interview was conducted with the crew as a group. In each test interpersonal conflict developed. This report describes how the crews dealt with the conflicts and other stressors associated with life in the Habitat. GRA

N89-15529*# California Univ., Davis. Dept. of Psychology.
IMPLICATIONS OF PRIVACY NEEDS AND INTERPERSONAL DISTANCING MECHANISMS FOR SPACE STATION DESIGN
Albert A. Harrison, Robert Sommer, Nancy Struthers, and Kathleen Hoyt Aug. 1988 53 p
(Grant NAG2-357)
(NASA-CR-177500; NAS 1.26:177500) Avail: NTIS HC A04/MF A01 CSCL 05I

Isolation, confinement, and the characteristics of microgravity will accentuate the need for privacy in the proposed NASA space station, yet limit the mechanism available for achieving it. This study proposes a quantitative model for understanding privacy, interpersonal distancing, and performance, and discusses the practical implications for Space Station design. A review of the relevant literature provided the basis for a database, definitions of physical and psychological distancing, loneliness, and crowding, and a quantitative model of situational privacy. The model defines situational privacy (the match between environment and task), and focuses on interpersonal contact along visual, auditory, olfactory, and tactile dimensions. It involves summing across pairs of crew members, contact dimensions, and time, yet also permits separate analyses of subsets of crew members and contact dimensions. The study concludes that performance will benefit when the type and level of contact afforded by the environment align with that required by the task. The key to achieving this is to design a flexible, definable, and redefinable interior environment that provides occupants with a wide array of options to meet their needs for solitude, limited social interaction, and open group activity. The report presents 49 recommendations in five categories to promote a wide range of privacy options despite the space station's volumetric limitations. Author

N89-15530*# Washington Univ., Seattle. Coll. of Architecture and Urban Planning.
THE QUANTITATIVE MODELLING OF HUMAN SPATIAL HABITABILITY
James A. Wise, Cherly Geisendorfer, Beverly Tiedje, David Lantrip, Brian Johnson, and Glen Geisendorfer Aug. 1988 156 p
(Grant NAG2-346)
(NASA-CR-177501; NAS 1.26:177501) Avail: NTIS HC A08/MF A01 CSCL 05I

A theoretical model for evaluating human spatial habitability (HuSH) in the proposed U.S. Space Station is developed. Optimizing the fitness of the space station environment for human occupancy will help reduce environmental stress due to long-term isolation and confinement in its small habitable volume. The development of tools that operationalize the behavioral bases of spatial volume for visual kinesthetic, and social logic considerations is suggested. This report further calls for systematic scientific investigations of how much real and how much perceived volume people need in order to function normally and with minimal stress in space-based settings. The theoretical model presented in this report can be applied to any size or shape interior, at any scale of consideration, for the Space Station as a whole to an individual enclosure or work station. Using as a point of departure the Isovist model developed by Dr. Michael Benedikt of the U. of Texas, the report

suggests that spatial habitability can become as amenable to careful assessment as engineering and life support concerns.
Author

N89-15531*# California Univ., Irvine. Program in Social Ecology.
HUMAN ADAPTATION TO ISOLATED AND CONFINED ENVIRONMENTS: PRELIMINARY FINDINGS OF A SEVEN MONTH ANTARCTIC WINTER-OVER HUMAN FACTORS STUDY
Gary W. Evans, Daniel Stokols, and Sybil Carrere Aug. 1988 143 p
(Grant NAG2-387)
(NASA-CR-177499; NAS 1.26:177499) Avail: NTIS HC A07/MF A01 CSCL 05I

This field study was conducted during the seven-month period of the 1985 austral winter-over at Palmer Station in the Antarctic. The purpose of the study was to understand temporal patterns in physiological arousal and psychological mood over the course of the mission. The investigators were principally interested in how people adapted over time to chronic and acute stressors, and how people use and modify their built environment. Physiological and psychological data were collected several times a week, and information on behavior and the use of physical facilities was collected monthly. Physiological and psychological data were compared with social changes in the setting toward the development of a sequential model of human-environment transactional relationships. Based on the study results, guidelines for design of future isolated and confined environments (ICEs) included: plan space for items which make people feel at home, provide materials to allow people to personalize their environment, allow for flexible environments, provide areas for visual and auditory privacy, equip areas for socializing and remove them from private areas, and provide facilities for exercise and for projects involving physical activity. The study offers guidelines about patterns of adaption that could be expected in an ICE, discusses how these settings can be programmed to facilitate successful adjustment, and provides information about how to design future ICE habitats to maximize a healthy living environment.
Author

N89-15532*# Washington Univ., Seattle. Dept. of Psychology.
THE HUMAN FACTORS OF COLOR IN ENVIRONMENTAL DESIGN: A CRITICAL REVIEW
Lee Roy Beach, Barbara K. Wise, and James A. Wise Aug. 1988 138 p
(Contract NCC2-404)
(NASA-CR-177498; NAS 1.26:177498) Avail: NTIS HC A07/MF A01 CSCL 05I

The literature on environmental color to enhance habitability in the design of Space Station interiors is reviewed. Some 200 studies were examined to determine the relative contributions of the three dimensions of color (hue, saturation, and brightness or lightness) to responses to environmental colorations. Implications of the study for color usage in novel settings and locales include: (1) There are no hard-wired linkages between environmental colors and particular judgmental or emotional states; (2) Perceptual impressions of color applications can, however, affect experiences and performances in settings; (3) Color behavior studies cannot yet specify an optimal color scheme, but instead must consider differing objectives, the relative importance of each, and design features such as the coordination of geometry, color, texture, etc.; (4) Some color-behavior effects are governed by low-level retinal and limbal mechanisms as well as by cognitive processes; and (5) Colors should first be specified in terms of what they are to do instead of what they are. Some exercise of choice is therefore needed to establish a sense of personal competence in the setting, since color must be ultimately be accepted by the people who are to live with it.
Author

N89-15533# FMC Corp., Santa Clara, CA.
DYNAMIC INSTRUCTIONAL PLANNING IN THE BB1 BLACKBOARD ARCHTECTURE
William R. Murray Aug. 1988 20 p
(Contract N00014-86-C-0487)
(AD-A199132; FMC-R-6168) Avail: NTIS HC A03/MF A01 CSCL 12E

An intelligent tutoring system that delivers effective instruction must select pedagogical actions appropriate to its tutorial situation. The approach taken in this research is to view this control problem as a dynamic planning problem. Dynamic instructional planning is the ability to generate, monitor, and revise instructional plans during the course of instruction. Planning and execution of instructional actions must be interleaved because the tutor operates in a changing environment with incomplete information. An appropriate architecture is the BB1 Blackboard Architecture, which supports the building of knowledge-based planners that represent and reason about their own actions. Dynamic instructional planning uses these capabilities to apply pedagogial knowledge to reason about instructional actions that a tutor can perform. We have built the Blackboard Instructional Planner in BB1 to teach troubleshooting a complex physical device by first imparting a mental model of the device and its operation. The planner generates instructional plans from skeletal plans, executes them, and monitors their effectiveness. Instructional plans are modified and particular instructional actions selected in response to changes in the student model, changes in resources available, requests and questions of the student, and to properties of the subject matter currently being presented.
GRA

N89-15534*# California Univ., Irvine. Program in Social Ecology.
HUMAN ADAPTATION TO ISOLATED AND CONFINED ENVIRONMENTS: PRELIMINARY FINDINGS OF A SEVEN MONTH ANTARCTIC WINTER-OVER HUMAN FACTORS STUDY Final Technical Report
Gary W. Evans, Daniel Stokols, and Sybil Carrere Aug. 1987 141 p
(Grants NAG2-387; NSF DPP-85-40817)
(NASA-CR-184664; NAS 1.26:184664) Avail: NTIS HC A07/MF A01 CSCL 05I

The study was conducted over a seven month period in a winter Antarctic isolated and confined environment (ICE). Physiological and psychological data were collected several times a week over the course of the winter. Information was collected on a monthly basis on behavior and the use of physical facilities. Adaptation information indicates that there was a significant decrease in epinephrine and norepinephrine during the middle trimeter of the winter. No significant changes were found for blood pressure over the seven months. Self reports of hostility and anxiety show a linear increase over winter. The physiological and psychological data do not move in a synchronous fashion over time. Behavioral adjustment information highlight the importance of developing schedules which balance work and recreational activities. Anxiety levels increased with the percentage of work hours reported. The increase in work towards the end of the winter underscores the need to pace work loads throughout the ICE tenure. Those individuals who reported the greatest variety of personal activities were the least depressed, hostile, and anxious of the crew. The data on the use and modification of the built environment provide guidelines for the design of future ICEs.
Author

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

N89-15535*# Life Systems, Inc., Cleveland, OH.
ALKALINE STATIC FEED ELECTROLYZER BASED OXYGEN GENERATION SYSTEM Final Report
L. D. Noble, A. J. Kovach, F. A. Fortunato, F. H. Schubert, and D. J. Grigger Oct. 1988 93 p

(Contract NAS9-17602)
(NASA-CR-172093; NAS 1.26:172093; TR-925-96) Avail: NTIS HC A05/MF A01 CSCL 06K

In preparation for the future deployment of the Space Station, an R and D program was established to demonstrate integrated operation of an alkaline Water Electrolysis System and a fuel cell as an energy storage device. The program's scope was revised when the Space Station Control Board changed the energy storage baseline for the Space Station. The new scope was aimed at the development of an alkaline Static Feed Electrolyzer for use in an Environmental Control/Life Support System as an oxygen generation system. As a result, the program was divided into two phases. The phase 1 effort was directed at the development of the Static Feed Electrolyzer for application in a Regenerative Fuel Cell System. During this phase, the program emphasized incorporation of the Regenerative Fuel Cell System design requirements into the Static Feed Electrolyzer electrochemical module design and the mechanical components design. The mechanical components included a Pressure Control Assembly, a Water Supply Assembly and a Thermal Control Assembly. These designs were completed through manufacturing drawing during Phase 1. The Phase 2 effort was directed at advancing the Alkaline Static Feed Electrolyzer database for an oxygen generation system. This development was aimed at extending the Static Feed Electrolyzer database in areas which may be encountered from initial fabrication through transportation, storage, launch and eventual Space Station startup. During this Phase, the Program emphasized three major areas: materials evaluation, electrochemical module scaling and performance repeatability and Static Feed Electrolyzer operational definition and characterization. Author

N89-15536# Anacapa Sciences, Inc., Fort Rucker, AL.
HUMAN FACTORS RESEARCH IN AIRCREW PERFORMANCE AND TRAINING Annual Summary Report, Feb. 1986 - Oct. 1987
Theodore B. Aldrich and Michael McAnulty Aug. 1988 128 p
(Contract MDA903-87-C-0523)
(AD-A199906; ASI-690-304-87; ARI-RN-88-84) Avail: NTIS HC A07/MF A01 CSCL 23B

This research note presents summary descriptions of research projects performed for ARI at Fort Rucker, Alabama. During the period 18 February 1986 through 8 October 1987, contractor personnel worked on 17 research projects in the areas of emerging system design, manpower and personnel, aviation simulation, and aviator training. The summary description for each project contains a background section that describes the rationale for the project, and specifies the research objectives, a research approach section that describes the tasks and activities required to meet the project objectives, a results section describing the research findings (or, in the case of developmental activities, the research products), and, finally, a project status section that describes the work completed and projections for future research, if any. GRA

N89-15537# Navy Clothing and Textile Research Facility, Natick, MA.
THE ALUMINIZED PROXIMITY CRASH-RESCUE COAT/TROUSER ENSEMBLE: A TECHNICAL EVALUATION Final Report, Oct. 1985 - Oct. 1987
M. W. Pine Jun. 1988 23 p
(AD-A199973; NCTRF-168) Avail: NTIS HC A03/MF A01 CSCL 15E

The Navy Clothing and Textile Research Facility (NCTRF) developed a lightweight, knitted, aluminized Kevlar fabric for fabrication of new fire proximity crash-rescue suits, which provided greater flexibility and comfort to the firefighter in performing his or her duties. The standard suit, fabricated of 100 percent woven Kevlar, was heavier, stiffer, and much more difficult to move in than the new proximity suit. The new aluminized proximity Kevlar knit crash-rescue (APCR) coat/trouser ensemble then underwent a technical evaluation to show compliance with several development test and evaluation (DT and E) threshold parameters, including flammability, burn injury, and radiant heat penetration. The DT and E results demonstrated that the new APCR ensemble consistently met or exceeded the results development test thresholds. GRA

N89-15538# Allen Corp. of America, Alexandria, VA.
DEVELOPMENT OF LHX (LIGHT HELICOPTER FAMILY) MANPRINT (MANPOWER AND PERSONNEL INTEGRATION) ISSUES Final Report, Mar. - Dec. 1986
Robert E. Jones, Jr., Robert C. Trexler, Jacob L. Barber, and Jerry L. Guthrie Sep. 1988 178 p
(AD-A199530; ARI-RN-88-88) Avail: NTIS HC A09/MF A01 CSCL 01C

This research note documents one stage in the incorporation of Manpower and Personnel Integration (MANPRINT) into the early stages of the acquisition of a major weapon system. It describes a process of identifying and analyzing the human factors, health hazard, and training issues associated with the Light Helicopter Family (LHX). The RN also describes the LHX MANPRINT Data Base Management System -- an automated data base whose structure and operation should be generally useful in any acquisition of material. GRA

N89-15539# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.
CONSIDERATIONS CONCERNING THE ASSESSMENT OF PILOT WORKLOAD FOR COMPLEX TASK CONDITIONS
R. C. vandeGraaf 25 Sep. 1987 19 p Presented at the AGARD Joint GCP/FMP Symposium on the Man-Machine Concept in Tactical Design and Combat Automation, Stuttgart, Fed. Republic of Germany, 28 Sep. - 2 Oct. 1987
(Contract NIVR-01406-N)
(NLR-MP-87069-U; ETN-89-93886) Avail: NTIS HC A03/MF A01

The problem of being able to draw conclusions from a variety (i.e., a matrix) of experimental measures in a complex task situation is discussed. Dealing with contradictory outcomes, the designating of artefacts, and formulating final conclusions without the (a-priori) availability of a superior method for evaluating other methods were examined in an in-flight study concerning the assessment of pilot workload under various instrument approach conditions for a fixed-wing (civil) transport aircraft. The experimental findings were compared with the results of an in-flight experiment dealing with pilot workload and performance during helicopter (instrument-flying) tasks. Subjective ratings, physiological measurements, and task performance measurements are assessed. A strategy for the formulation of final conclusions based on the outcomes of a matrix of measures is suggested. ESA

55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

N89-15826*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
A LUNAR BASE FOR SETI (SEARCH FOR EXTRATERRESTRIAL INTELLIGENCE)
Bernard M. Oliver *In* NASA, Lyndon B. Johnson Space Center, Future Astronomical Observatories on the Moon Mar. 1988 p 119-123 (For primary document see N89-15810 07-89)
Avail: NTIS HC A07/MF A01 CSCL 06C

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

N89-15540*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
INVESTIGATING A HYBRID PERTURBATION-GALERKIN TECHNIQUE USING COMPUTER ALGEBRA Final Report

Carl M. Andersen and James F. Geer (State Univ. of New York, Binghamton.) Nov. 1988 27 p Submitted for publication
(Contracts NAS1-18107; NAS1-18605)
(NASA-CR-181750; ICASE-88-65; NAS 1.26:181750) Avail: NTIS HC A03/MF A01 CSCL 12A

A two-step hybrid perturbation-Galerkin method is presented for the solution of a variety of differential equations type problems which involve a scalar parameter. The resulting (approximate) solution has the form of a sum where each term consists of the product of two functions. The first function is a function of the independent field variable(s) x, and the second is a function of the parameter lambda. In step one the functions of x are determined by forming a perturbation expansion in lambda. In step two the functions of lambda are determined through the use of the classical Bubnov-Galerkin method. The resulting hybrid method has the potential of overcoming some of the drawbacks of the perturbation and Bubnov-Galerkin methods applied separately, while combining some of the good features of each. In particular, the results can be useful well beyond the radius of convergence associated with the perturbation expansion. The hybrid method is applied with the aid of computer algebra to a simple two-point boundary value problem where the radius of convergence is finite and to a quantum eigenvalue problem where the radius of convergence is zero. For both problems the hybrid method apparently converges for an infinite range of the parameter lambda. The results obtained from the hybrid method are compared with approximate solutions obtained by other methods, and the applicability of the hybrid method to broader problem areas is discussed. Author

60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

N89-15541# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.
MODULAR SYSTEM FOR SPECTROSCOPIC DATA ACQUISITION. MULTI-CHANNEL ANALYZER
Ya. Boja, V. A. Vagov, G. P. Zhukov, D. Rubin, and Zh. Kharangozo 1987 19 p In RUSSIAN; ENGLISH summary
(DE88-703768; JINR-R-10-87-691) Avail: NTIS (US Sales Only) HC A03/MF A01

A Multichannel Analyser of the CAMAC data acquisition system having modular architecture is described. It is intended for experimental data processing: receiving analysing and storing. The system provides setting of: 4 K volume memory address field; offset of memory working field: address and data overflow test; word length of memory 12/24 bit; data block and word transmission in programmable way. The maximum memory capacity of the analyser is 32 K x 24 bit. DOE

N89-15542# California Univ., Berkeley. Computer Science Div.
DESIGN AND IMPLEMENTATION OF A CMOS CHIP FOR A PROLOG Technical Report, 7 Aug. 1984 - 6 Aug. 1987
Vason P. Srini, Jerric V. Tam, Tam M. Nguyen, Bruce K. Holmer, Yale N. Patt, Alvin M. Despain, and S. L. Graham Mar. 1988 127 p
(Contract N00039-84-C-0079; ARPA Order 4871)
(AD-A198304) Avail: NTIS HC A07/MF A01 CSCL 12F

A high performance VLSI chip for executing Prolog programs is designed and fabricated using a 1.4 micron CMOS technology with two layers of metal. This chip implements a tagged architecture with hardware support for five stacks. The 32-bit data path of the chip contains a fast ALU, 64 registers in four groups, five counters, and six non-master/slave registers. The control is microprogrammed and uses a 512 x 160 bit ROM with four pages for fast microbranching. The chip operates at a cycle time of 100 ns (worst case) and has a size of 10 mm x 9 mm. A semicustom design methodology employing Mentor and NCR tools has been used in this design. The challenges involved in the design, verification, routing, and fabrication of the chip are described. GRA

N89-15543# University of Southern California, Los Angeles. Signal and Image Processing Inst.
RESEARCH IN OPTICAL SYMBOLIC COMPUTING TASKS Annual Progress Report, 1 Jun. 1987 - 31 May 1988
B. K. Jenkins 31 May 1988 68 p
(Grant AF-AFOSR-0196-86; AF Proj. 2305)
(AD-A199998; AFOSR-88-0999TR) Avail: NTIS HC A04/MF A01 CSCL 09E

This report concentrated on the following topics: complexity studies for optical neural and digital systems and learning algorithms for neural networks. Several conference and journal papers reporting the research findings have been published. A list of publications and presentations is given at the end of the report along with a set of reprints and preprints. GRA

N89-15544# Illinois Univ., Urbana. Coll. of Engineering.
INSTRUCTION SETS FOR PARALLEL RANDOM ACCESS MACHINES Ph.D. Thesis
Jerry L. Trahan Aug. 1988 172 p
(Contract N00014-84-C-0149)
(AD-A199438; UILU-ENG-88-2249; ACT-99) Avail: NTIS HC A08/MF A01 CSCL 12E

An important model of parallel computation is the Parallel Random Access Machine (PRAM), which comprises multiple processors that execute instructions synchronously and share a common memory. Formalized by Fortune and Wyllie (1978) and Goldschlager (1982), the PRAM is a much more natural model of parallel computation than older models such as combinational circuits and alternating Turing machines (Ruzzo, 1981) because the PRAM abstracts the salient features of a modern multiprocessor computer. Eventually an algorithm developed for the PRAM can be implemented on a parallel network computer such as a mesh-connected array computer (Thompson and Kung, 1977), a hypercube machine (Seitz, 1985), a cube-connected cycles machine (Preparata and Vuillemin, 1981) or a bounded degree processor network (Alt et al., 1987); on all network computers the routing of data complicates the implementation of algorithms. The PRAM provides the foundation for the design of highly parallel algorithms (Luby), 1986; Miller and Reif, 1985; among many others. This model permits the exposure of the intrinsic parallelism in a computational problem because it simplifies the communication of data through a shared memory. To quantify differences in computational in computational performance, we determine the time complexities of simulations between PRAMS with different instruction sets. GRA

N89-15545# Argonne National Lab., IL.
ON ENHANCING HYPERCUBE MULTIPROCESSORS
A. H. Esfahanian, Lionel M. Ni, and B. E. Sagan (Michigan State Univ., East Lansing.) 1988 5 p Presented at the International Conference on Parallel Processing, St. Charles, IL, 15 Aug. 1988
(Contract W-31-109-eng-38)
(DE89-000534; CONF-8808140-1) Avail: NTIS HC A02

We show that by exchanging any two independent edges in any shortest cycle of the n-cube (n is greater than or equal to 3), its diameter decreases by one unit. This leads us to define a new class of n-regular graphs, denoted TQ(sub n), with 2(sup n) vertices and diameter n-1, which has the (n-1)-cube as subgraph. Other properties of TQ(sub n) such as connectivity and the lengths of the disjoints paths are also investigated. Moreover, we show that the complete binary tree on 2(sup n)-1 vertices, which is not a subgraph of the n-cube, is a subgraph of TQ(sub n). Finally, we discuss how these results can be used to enhance existing hypercube multiprocessors. DOE

N89-15546# Los Alamos National Lab., NM.
SUPERCOMPUTERS AND ATOMIC PHYSICS DATA
Joseph Abdallah, Jr. and Robert E. H. Clark 1988 8 p Presented at the Supercomputing Conference, Orlando, FL, 14 Nov. 1988

(Contract W-7405-eng-36)
(DE88-007903; LA-UR-88-771; CONF-881112-2) Avail: NTIS HC A02/MF A01

The advent of the supercomputer has dramatically increased the possibilities for generating and using massive amounts of detailed fine structure atomic physics data. Size, speed, and software have made calculations which were impossible just a few years ago into a reality. Further technological advances make future possibilities seem endless. The cornerstone atomic structure codes of R. D. Cowan have been adapted into a single code CATS for use on Los Alamos supercomputers. We provide a brief overview of the problem; and report a sample CATS calculation using configuration interaction to calculate collision and oscillator strengths for over 300,000 transitions in neutral nitrogen. We also discuss future supercomputer needs. DOE

N89-15547# Los Alamos National Lab., NM. Computing and Communications Div.
PERFORMANCE COMPARISON OF THE CRAY-2 AND CRAY X-MP/416 SUPERCOMPUTERS
Margaret L. Simmons and Harvey J. Wasserman 1988 9 p Presented at the Supercomputing Conference, Orlando, FL, 14 Nov. 1988
(Contract W-7405-eng-36)
(DE88-014338; LA-UR-88-2391; CONF-881112-7) Avail: NTIS HC A02/MF A01

The serial and parallel performance of one of the world's fastest general purpose computers, the CRAY-2, is analyzed using the standard Los Alamos Benchmark Set plus codes adopted for parallel processing. For comparison, architectural and performance data are also given for the CRAY X-MP/416. Factors affecting performance, such as memory bandwidth, size and access speed of memory, and software exploitation of hardware, are examined. The parallel processing environments of both machines are evaluated, and speed-up measurements for the parallel codes are given. DOE

N89-15548# Oak Ridge National Lab., TN. Energy Div.
WHY ARE COMPUTER SYSTEMS SO DIFFICULT TO BUILD
James L. Hardee and Al H. Voelker 1988 5 p Presented at the 24th Annual Meeting of the Institute of Management Science - Southeastern Chapter, Myrtle Beach, SC, 6 Oct. 1988
(Contract DE-AC05-84OR-21400)
(DE89-001204; CONF-8810187-1) Avail: NTIS HC A02/MF A01

The difficulties experienced in computer systems development have been widely documented and discussed over the past two decades. According to a recent survey, 75 percent of all systems development efforts are either never completed or, if completed, never used. There is a growing consensus that most computer system problems relate to social rather than technical aspects of systems development and implementation. This paper argues that the development success rate can be improved, but only after a broader conceptual view of systems development matures that is sensitive to social, organizational, and political issues. Furthermore, this conceptual view can only be developed after we have destroyed some of the fallacies in current systems development practice that are largely responsible for the insensitivity to these issues. The paper lists and describes some of the most serious of these fallacies. DOE

N89-15597*# Lockheed Missiles and Space Co., Menlo Park, CA. Artificial Intelligence Center.
A MULTIPROCESSING ARCHITECTURE FOR REAL-TIME MONITORING Abstract Only
James L. Schmidt, Simon M. Kao, Jackson Y. Read, Scott M. Weitzenkamp, and Thomas J. Laffey *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 369 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

N89-15598*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
PI-IN-A-BOX: INTELLIGENT ONBOARD ASSISTANCE FOR SPACEBORNE EXPERIMENTS IN VESTIBULAR PHYSIOLOGY
Silvano Colombano, Laurence Young, Nancy Wogrin (Stanford Univ., CA.), and Don Rosenthal *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 371-380 Prepared in cooperation with Digital Equipment Corp., Palo Alto, CA (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, alogorithms, and specific applications, e.g., CAD/CAM.

N89-15549*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
FOURTH CONFERENCE ON ARTIFICIAL INTELLIGENCE FOR SPACE APPLICATIONS
Stephen L. ODell, comp., Judith S. Denton, comp., and Mary Vereen, comp. Oct. 1988 485 p Conference held in Huntsville, AL, 15-16 Nov. 1988; sponsored by NASA and Alabama Univ., Huntsville
(NASA-CP-3013; M-599; NAS 1.55:3013) Avail: NTIS HC A21/MF A01 CSCL 09B

Proceedings of a conference held in Huntsville, Alabama, on November 15-16, 1988. The Fourth Conference on Artificial Intelligence for Space Applications brings together diverse technical and scientific work in order to help those who employ AI methods in space applications to identify common goals and to address issues of general interest in the AI community. Topics include the following: space applications of expert systems in fault diagnostics, in telemetry monitoring and data collection, in design and systems integration; and in planning and scheduling; knowledge representation, capture, verification, and management; robotics and vision; adaptive learning; and automatic programming. For individual titles, see N89-15550 through N89-15610.

N89-15550*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
CONSIDERATIONS IN DEVELOPMENT OF EXPERT SYSTEMS FOR REAL-TIME SPACE APPLICATIONS
S. Murugesan *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 1-3 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

Over the years demand on space systems have been increased tremendously and this trend will continue for the near future. The enhanced capabilities of space systems, however, can only be met with increased complexity and sophistication of onboard and ground systems, and artificial intelligence and expert system concepts have a significant role in space applications. Expert systems could facilitate decision making, improved fault diagnosis and repair, enhanced performance and less reliance on ground support. However, some requirements have to be fulfilled before practical use of flight-worthy expert systems for onboard (and ground) operations. This paper discusses some of the characteristics and important considerations in design, development, implementation and use of expert systems for real-life space applications. Further, it describes a typical life cycle of expert system development and its usage. Author

N89-15551*# Rockwell International Corp., Palo Alto, CA. Science Center.
REAL-TIME CONTROL FOR MANUFACTURING SPACE SHUTTLE MAIN ENGINES: WORK IN PROGRESS **c63**
Corinne C. Ruokangas *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications

Oct. 1988 p 5-18 (For primary document see N89-15549 07-61)
(Contract NAS8-40000)
Avail: NTIS HC A21/MF A01 CSCL 09B

During the manufacture of space-based assemblies such as Space Shuttle Main Engines, flexibility is required due to the high-cost and low-volume nature of the end products. Various systems have been developed pursuing the goal of adaptive, flexible manufacturing for several space applications, including an Advanced Robotic Welding System for the manufacture of complex components of the Space Shuttle Main Engines. The Advanced Robotic Welding System (AROWS) is an on-going joint effort, funded by NASA, between NASA/Marshall Space Flight Center, and two divisions of Rockwell International: Rocketdyne and the Science Center. AROWS includes two levels of flexible control of both motion and process parameters: Off-line programming using both geometric and weld-process data bases, and real-time control incorporating multiple sensors during weld execution. Both control systems were implemented using conventional hardware and software architectures. The feasibility of enhancing the real-time control system using the problem-solving architecture of Schemer is investigated and described. Author

N89-15552*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SOLUTIONS TO TIME VARIANT PROBLEMS OF REAL-TIME EXPERT SYSTEMS
Show-Way Yeh, Chuan-lin Wu (Texas Univ., Austin.), and Chaw-Kwei Hung *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 19-28 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

Real-time expert systems for monitoring and control are driven by input data which changes with time. One of the subtle problems of this field is the propagation of time variant problems from rule to rule. This propagation problem is even complicated under a multiprogramming environment where the expert system may issue test commands to the system to get data and to access time consuming devices to retrieve data for concurrent reasoning. Two approaches are used to handle the flood of input data. Snapshots can be taken to freeze the system from time to time. The expert system treats the system as a stationary one and traces changes by comparing consecutive snapshots. In the other approach, when an input is available, the rules associated with it are evaluated. For both approaches, if the premise condition of a fired rule is changed to being false, the downstream rules should be deactivated. If the status change is due to disappearance of a transient problem, actions taken by the fired downstream rules which are no longer true may need to be undone. If a downstream rule is being evaluated, it should not be fired. Three mechanisms for solving this problem are discussed: tracing, backward checking, and censor setting. In the forward tracing mechanism, when the premise conditions of a fired rule become false, the premise conditions of downstream rules which have been fired or are being evaluated due to the firing of that rule are reevaluated. A tree with its root at the rule being deactivated is traversed. In the backward checking mechanism, when a rule is being fired, the expert system checks back on the premise conditions of the upstream rules that result in evaluation of the rule to see whether it should be fired. The root of the tree being traversed is the rule being fired. In the censor setting mechanism, when a rule is to be evaluated, a censor is constructed based on the premise conditions of the upstream rules and the censor is evaluated just before the rule is fired. Unlike the backward checking mechanism, this one does not search the upstream rules. This paper explores the details of implementation of the three mechanisms. Author

N89-15553*# Michigan State Univ., East Lansing. AI/KBS Group-Dept. of CPS.
FUNCTIONAL REASONING IN DIAGNOSTIC PROBLEM SOLVING
Jon Sticklen, W. E. Bond, and D. C. StClair (McDonnell-Douglas Research Labs., St. Louis, MO.) *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 29-38 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

This work is one facet of an integrated approach to diagnostic problem solving for aircraft and space systems currently under development. The authors are applying a method of modeling and reasoning about deep knowledge based on a functional viewpoint. The approach recognizes a level of device understanding which is intermediate between a compiled level of typical Expert Systems, and a deep level at which large-scale device behavior is derived from known properties of device structure and component behavior. At this intermediate functional level, a device is modeled in three steps. First, a component decomposition of the device is defined. Second, the functionality of each device/subdevice is abstractly identified. Third, the state sequences which implement each function are specified. Given a functional representation and a set of initial conditions, the functional reasoner acts as a consequence finder. The output of the consequence finder can be utilized in diagnostic problem solving. The paper also discussed ways in which this functional approach may find application in the aerospace field. Author

N89-15554*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
THE ELEMENTS OF DESIGN KNOWLEDGE CAPTURE
Michael S. Freeman *In its* Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 39-46 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

This paper will present the basic constituents of a design knowledge capture effort. This will include a discussion of the types of knowledge to be captured in such an effort and the difference between design knowledge capture and more traditional knowledge base construction. These differences include both knowledge base structure and knowledge acquisition approach. The motivation for establishing a design knowledge capture effort as an integral part of major NASA programs will be outlined, along with the current NASA position on that subject. Finally the approach taken in design knowledge capture for Space Station will be contrasted with that used in the HSTDEK project. Author

N89-15555*# Phase Linear Systems, Inc., Fairfax, VA.
KAM (KNOWLEDGE ACQUISITION MODULE): A TOOL TO SIMPLIFY THE KNOWLEDGE ACQUISITION PROCESS c82
Gary A. Gettig *In* NASA, Marshall Space Flight Center, Fourth Confnce on Artificial Intelligence for Space Applications Oct. 1988 p 47-55 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 05B

Analysts, knowledge engineers and information specialists are faced with increasing volumes of time-sensitive data in text form, either as free text or highly structured text records. Rapid access to the relevant data in these sources is essential. However, due to the volume and organization of the contents, and limitations of human memory and association, frequently: (1) important information is not located in time; (2) reams of irrelevant data are searched; and (3) interesting or critical associations are missed due to physical or temporal gaps involved in working with large files. The Knowledge Acquisition Module (KAM) is a microcomputer-based expert system designed to assist knowledge engineers, analysts, and other specialists in extracting useful knowledge from large volumes of digitized text and text-based files. KAM formulates non-explicit, ambiguous, or vague relations, rules, and facts into a manageable and consistent formal code. A library of system rules or heuristics is maintained to control the extraction of rules, relations, assertions, and other patterns from the text. These heuristics can be added, deleted or customized by the user. The user can further control the extraction process with optional topic specifications. This allows the user to cluster extracts based on specific topics. Because KAM formalizes diverse knowledge, it can be used by a variety of expert systems and automated reasoning applications. KAM can also perform important roles in computer-assisted training and skill development. Current

research efforts include the applicability of neural networks to aid in the extraction process and the conversion of these extracts into standard formats. Author

N89-15556*# Alabama Univ., Huntsville. Dept. of Computer Science.
DESIGN OF AN EXPERT SYSTEM FOR ESTIMATING THE COST OF NEW KNOWLEDGE IN HIGH ENERGY ASTROPHYSICS Abstract Only
Edward L. Bosworth, Jr. and A. J. Fennelly (Teledyne Brown Engineering, Huntsville, AL.) *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 57 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

The High Energy Astrophysics Costing Tool (HEACT) is a combined Expert System/Numerical Simulation to evaluate sensors and experiments proposed for space platforms in order to determine their expected performance and to assess the amount and quality of scientific information likely to be gathered by such experiments. The end product of this tool will be both a cost estimate for the experiment package as deployed and also an estimate of the amount of new scientific knowledge (both new data and reductions in the uncertainties of previous measurements) which would result from the actual deployment and operation of that experiment package. The numerical simulation part of HEACT will contain components to: (1) calculate the high energy signatures of both actual and proposed classes of astrophysical objects, and (2) model the response and resolution of the candidate sensors for observing those objects. The rule based part of the HEACT will be based on knowledge in the areas of experiment design, instrument selection, and system integration developed from experience with existing high energy astrophysics observatories, both orbiting and lofted by rockets or balloons. This paper presents mainly results from the design of the rule-based part of HEACT. It focuses on the structure of the rules and the structures used to represent the knowledge related to the design and integration of such experiments. Methods for integrating the results from numerical simulations into the expert system will also be discussed. Author

N89-15557*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
ISSUES IN MANAGEMENT OF ARTIFICIAL INTELLIGENCE BASED PROJECTS c63
P. A. Kiss (BDM Corp., Huntsville, AL.) and Michael S. Freeman *In its* Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 59-66 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

Now that Artificial Intelligence (AI) is gaining acceptance, it is important to examine some of the obstacles that still stand in the way of its progress. Ironically, many of these obstacles are related to management and are aggravated by the very characteristcs that make AI useful. The purpose of this paper is to heighten awareness of management issues in AI development and to focus attention on their resolution. Author

N89-15558*# National Aeronautics and Space Administration, Washington, DC.
DEVELOPMENT OF AN EXPERT PLANNING SYSTEM FOR OSSA Abstract Only c81
B. Groundwater, M. F. Lembeck, L. Sarsfield (Science Applications International Corp., Wayne, PA.), and Alphonso Diaz *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 67 (For primary document see N89-15549 07-61)
(Contract NASw-4092)
Avail: NTIS HC A21/MF A01 CSCL 05A

This paper presents concepts related to preliminary work for the development of an expert planning system for NASA's Office for Space Science and Applications (OSSA). The expert system will function as a planner's decision aid in preparing mission plans encompassing sets of proposed OSSA space science initiatives. These plans in turn will be checked against budgetary and technical constraints and tested for constraint violations. Appropriate advice will be generated by the system for making modifications to the plans to bring them in line with the constraints. The OSSA Planning Expert System (OPES) has been designed to function as an integral part of the OSSA mission planning process. It will be able to suggest a best plan, be able to accept and check a user-suggested strawman plan, and should provide a quick response to user request and actions. OPES will be written in the C programming language and have a transparent user interface running under Windows 386 on a Compaq 386/20 machine. The system's sorted knowledge and inference procedures will model the expertise of human planners familiar with the OSSA planning domain. Given mission priorities and budget guidelines, the system first sets the launch dates for each mission. It will check to make sure that planetary launch windows and precursor mission relationships are not violated. Additional levels of constraints will then be considered, checking such things as the availability of a suitable launch vehicle, total mission launch mass required vs. the identified launch mass capability, and the total power required by the payload at its destination vs. the actual power available. System output will be in the form of Gantt charts, spreadsheet hardcopy, and other presentation quality materials detailing the resulting OSSA mission plan. Author

N89-15559*# Alabama A & M Univ., Huntsville. Dept. of Computer and Information Science.
PLANNING ACTIONS IN ROBOT AUTOMATED OPERATIONS c63
A. Das *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 69-74 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

Action planning in robot automated operations requires intelligent task level programming. Invoking intelligence necessiates a typical blackboard based architecture, where, a plan is a vector between the start frame and the goal frame. This vector is composed of partially ordered bases. A partial ordering of bases presents good and bad sides in action planning. Partial ordering demands the use of a temporal data base management system. Author

N89-15560*# Worcester Polytechnic Inst., MA.
INTEGRATION OF TASK LEVEL PLANNING AND DIAGNOSIS FOR AN INTELLIGENT ROBOT c63
Arthur Gerstenfeld *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 75-84 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

The use of robots in the future must go beyond present applications and will depend on the ability of a robot to adapt to a changing environment and to deal with unexpected scenarios (i.e., picking up parts that are not exactly where they were expected to be). The objective of this research is to demonstrate the feasibility of incorporating high level planning into a robot enabling it to deal with anomalous situations in order to minimize the need for constant human instruction. The heuristics can be used by a robot to apply information about previous actions towards accomplishing future objectives more efficiently. The system uses a decision network that represents the plan for accomplishing a task. This enables the robot to modify its plan based on results of previous actions. The system serves as a method for minimizing the need for constant human instruction in telerobotics. This paper describes the integration of expert systems and simulation as a valuable tool that goes far beyond this project. Simulation can be expected to be used increasingly as both hardware and software improve. Similarly, the ability to merge an expert system with simulation means that we can add intelligence to the system. A malfunctioning space satellite is described. The expert system uses a series of heuristics in order to guide the robot to the proper location. This is part of task level planning. The final part of the paper suggests directions for future research. Having shown the

feasibility of an expert system embedded in a simulation, the paper then discusses how the system can be integrated with the MSFC graphics system. Author

N89-15561*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
A GRAPHICAL, RULE BASED ROBOTIC INTERFACE SYSTEM
c63
James W. McKee (Alabama Univ., Huntsville.) and John Wolfsberger *In its* Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 85-91 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

The ability of a human to take control of a robotic system is essential in any use of robots in space in order to handle unforeseen changes in the robot's work environment or scheduled tasks. But in cases in which the work environment is known, a human controlling a robot's every move by remote control is both time consuming and frustrating. A system is needed in which the user can give the robotic system commands to perform tasks but need not tell the system how. To be useful, this system should be able to plan and perform the tasks faster than a telerobotic system. The interface between the user and the robot system must be natural and meaningful to the user. A high level user interface program under development at the University of Alabama, Huntsville, is described. A graphical interface is proposed in which the user selects objects to be manipulated by selecting representations of the object on projections of a 3-D model of the work environment. The user may move in the work environment by changing the viewpoint of the projections. The interface uses a rule based program to transform user selection of items on a graphics display of the robot's work environment into commands for the robot. The program first determines if the desired task is possible given the abilities of the robot and any constraints on the object. If the task is possible, the program determines what movements the robot needs to make to perform the task. The movements are transformed into commands for the robot. The information defining the robot, the work environment, and how objects may be moved is stored in a set of data bases accessible to the program and displayable to the user. Author

N89-15562*# Martin Marietta Corp., Huntsville, AL. Manned Space Systems.
PDA: A COUPLING OF KNOWLEDGE AND MEMORY FOR CASE-BASED REASONING Abstract Only
S. Bharwani, J. Walls, and E. Blevins *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 93-94 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

Problem solving in most domains requires reference to past knowledge and experience whether such knowledge is represented as rules, decision trees, networks or any variant of attributed graphs. Regardless of the representational form employed, designers of expert systems rarely make a distinction between the static and dynamic aspects of the system's knowledge base. The current paper clearly distinguishes between knowledge-based and memory-based reasoning where the former in its most pure sense is characterized by a static knowledge based resulting in a relatively brittle expert system while the latter is dynamic and analogous to the functions of human memory which learns from experience. The paper fiscusses the design of an advisory system which combines a knowledge base consisting of domain vocabulary and default dependencies between concepts with a dynamic conceptual memory which stores experimental knowledge in the form of cases. The case memory organizes past experience in the form of MOPs (memory organization packets) and sub-MOPs. Each MOP consists of a context frame and a set of indices. The context frame contains information about the features (norms) common to all the events and sub-MOPs indexed under it. Author

N89-15563*# California Univ., Berkeley. Div. of Computer Science.
APPROXIMATE SPATIAL REASONING Abstract Only
Soumitra Dutta *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 95-95 (For primary document see N89-15549 07-61)
(Contract NCC2-275)
Avail: NTIS HC A21/MF A01 CSCL 09B

Much of human reasoning is approximate in nature. Formal models of reasoning traditionally try to be precise and reject the fuzziness of concepts in natural use and replace them with non-fuzzy scientific explicata by a process of precisiation. As an alternate to this approach, it has been suggested that rather than regard human reasoning processes as themselves approximating to some more refined and exact logical process that can be carried out with mathematical precision, the essence and power of human reasoning is in its capability to grasp and use inexact concepts directly. This view is supported by the widespread fuzziness of simple everyday terms (e.g., near tall) and the complexity of ordinary tasks (e.g., cleaning a room). Spatial reasoning is an area where humans consistently reason approximately with demonstrably good results. Consider the case of crossing a traffic intersection. We have only an approximate idea of the locations and speeds of various obstacles (e.g., persons and vehicles), but we nevertheless manage to cross such traffic intersections without any harm. The details of our mental processes which enable us to carry out such intricate tasks in such apparently simple manner are not well understood. However, it is that we try to incorporate such approximate reasoning techniques in our computer systems. Approximate spatial reasoning is very important for intelligent mobile agents (e.g., robots), specially for those operating in uncertain or unknown or dynamic domains. Author

N89-15564*# Rockwell International Corp., Huntsville, AL.
REPRESENTATION AND MATCHING OF KNOWLEDGE TO DESIGN DIGITAL SYSTEMS
J. U. Jones and S. G. Shiva (Alabama Univ., Huntsville.) *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 97-106 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

A knowledge-based expert system is described that provides an approach to solve a problem requiring an expert with considerable domain expertise and facts about available digital hardware building blocks. To design digital hardware systems from their high level VHDL (Very High Speed Integrated Circuit Hardware Description Language) representation to their finished form, a special data representation is required. This data representation as well as the functioning of the overall system is described.
Author

N89-15565*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
VULNERABILITY-ATTENTION ANALYSIS FOR SPACE-RELATED ACTIVITIES
Donnie Ford, Dan Hays, Sung Yong Lee (Alabama Univ., Huntsville.), and John Wolfsberger *In its* Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 107-114 Prepared in cooperation with NASA/Lyndon B. Johnson Space Center, Houston, TX (For primary document see N89-15549 07-61)
(Grant NAG8-641)
Avail: NTIS HC A21/MF A01 CSCL 09B

Techniques for representing and analyzing trouble spots in structures and processes are discussed. Identification of vulnerable areas usually depends more on particular and often detailed knowledge than on algorithmic or mathematical procedures. In some cases, machine inference can facilitate the identification. The analysis scheme proposed first establishes the geometry of the process, then marks areas that are conditionally vulnerable. This provides a basis for advice on the kinds of human attention or machine sensing and control that can make the risks tolerable.
Author

N89-15566*# Vanderbilt Univ., Nashville, TN.
GRAPH-BASED REAL-TIME FAULT DIAGNOSTICS
S. Padalkar, G. Karsai, and J. Sztipanovits *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 115-123 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

A real-time fault detection and diagnosis capability is absolutely crucial in the design of large-scale space systems. Some of the existing AI-based fault diagnostic techniques like expert systems and qualitative modelling are frequently ill-suited for this purpose. Expert systems are often inadequately structured, difficult to validate and suffer from knowledge acquisition bottlenecks. Qualitative modelling techniques sometimes generate a large number of failure source alternatives, thus hampering speedy diagnosis. In this paper we present a graph-based technique which is well suited for real-time fault diagnosis, structured knowledge representation and acquisition and testing and validation. A Hierarchical Fault Model of the system to be diagnosed is developed. At each level of hierarchy, there exist fault propagation digraphs denoting causal relations between failure modes of subsystems. The edges of such a digraph are weighted with fault propagation time intervals. Efficient and restartable graph algorithms are used for on-line speedy identification of failure source components. Author

N89-15567*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
AUTOMATIC DETECTION OF ELECTRIC POWER TROUBLES (ADEPT)
Caroline Wang, Hugh Zeanah, Audie Anderson, Clint Patrick, Mike Brady, and Donnie Ford (Alabama Univ., Huntsville.) *In its* Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 125-130 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

ADEPT is an expert system that integrates knowledge from three different suppliers to offer an advanced fault-detection system, and is designed for two modes of operation: real-time fault isolation and simulated modeling. Real time fault isolation of components is accomplished on a power system breadboard through the Fault Isolation Expert System (FIES II) interface with a rule system developed in-house. Faults are quickly detected and displayed and the rules and chain of reasoning optionally provided on a Laser printer. This system consists of a simulated Space Station power module using direct-current power supplies for Solar arrays on three power busses. For tests of the system's ability to locate faults inserted via switches, loads are configured by an INTEL microcomputer and the Symbolics artificial intelligence development system. As these loads are resistive in nature, Ohm's Law is used as the basis for rules by which faults are located. The three-bus system can correct faults automatically where there is a surplus of power available on any of the three busses. Techniques developed and used can be applied readily to other control systems requiring rapid intelligent decisions. Simulated modelling, used for theoretical studies, is implemented using a modified version of Kennedy Space Center's KATE (Knowledge-Based Automatic Test Equipment), FIES II windowing, and an ADEPT knowledge base. A load scheduler and a fault recovery system are currently under development to support both modes of operation. Author

N89-15568*# Alabama Univ., Huntsville. Dept. of Computer Science.
AN OVERVIEW OF VERY HIGH LEVEL SOFTWARE DESIGN METHODS
Maryam Asdjodi and James W. Hooper *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 131-140 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

Very High Level design methods emphasize automatic transfer of requirements to formal design specifications, and/or may concentrate on automatic transformation of formal design specifications that include some semantic information of the system into machine executable form. Very high level design methods range from general domain independent methods to approaches implementable for specific applications or domains. Applying AI techniques, abstract programming methods, domain heuristics, software engineering tools, library-based programming and other methods different approaches for higher level software design are being developed. Though one finds that a given approach does not always fall exactly in any specific class, this paper provides a classification for very high level design methods including examples for each class. These methods are analyzed and compared based on their basic approaches, strengths and feasibility for future expansion toward automatic development of software systems. Author

N89-15569*# Alabama Univ., Huntsville. Dept. of Computer Science.
ARTIFICIAL INTELLIGENCE APPROACHES TO SOFTWARE ENGINEERING **c63**
James D. Johannes and James R. MacDonald *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 141-150 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

Artificial intelligence approaches to software engineering are examined. The software development life cycle is a sequence of not so well-defined phases. Improved techniques for developing systems have been formulated over the past 15 years, but pressure continues to attempt to reduce current costs. Software development technology seems to be standing still. The primary objective of the knowledge-based approach to software development presented in this paper is to avoid problem areas that lead to schedule slippages, cost overruns, or software products that fall short of their desired goals. Identifying and resolving software problems early, often in the phase in which they first occur, has been shown to contribute significantly to reducing risks in software development. Software development is not a mechanical process but a basic human activity. It requires clear thinking, work, and rework to be successful. The artificial intelligence approaches to software engineering presented support the software development life cycle through the use of software development techniques and methodologies in terms of changing current practices and methods. These should be replaced by better techniques that that improve the process of of software development and the quality of the resulting products. The software development process can be structured into well-defined steps, of which the interfaces are standardized, supported and checked by automated procedures that provide error detection, production of the documentation and ultimately support the actual design of complex programs. Author

N89-15570*# University of Southwestern Louisiana, Lafayette. Center for Advanced Computer Studies.
AUTOMATIC PROGRAMMING FOR CRITICAL APPLICATIONS Abstract Only
Raj L. Logananthara *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 151-152 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

The important phases of a software life cycle include verification and maintenance. Usually, the execution performance is an expected requirement in a software development process. Unfortunately, the verification and the maintenance of programs are the time consuming and the frustrating aspects of software engineering. The verification cannot be waived for the programs used for critical applications such as, military, space, and nuclear plants. As a consequence, synthesis of programs from specifications, an alternative way of developing correct programs, is becoming popular. The definition, or what is understood by automatic programming, has been changed with our expectations. At present, the goal of automatic programming is the automation

of programming process. Specifically, it means the application of artificial intelligence to software engineering in order to define techniques and create environments that help in the creation of high level programs. The automatic programming process may be divided into two phases: the problem acquisition phase and the program synthesis phase. In the problem acquisition phase, an informal specification of the problem is transformed into an unambiguous specification while in the program synthesis phase such a specification is further transformed into a concrete, executable program. Author

N89-15571*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
USING AUTOMATIC PROGRAMMING FOR SIMULATING RELIABILITY NETWORK MODELS
Fan T. Tseng, Bernard J. Schroer, S. X. Zhang (Northwestern Polytechnical Univ., Xian, China), and John W. Wolfsberger *In its* Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 153-162 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

This paper presents the development of an automatic programming system for assisting modelers of reliability networks to define problems and then automatically generate the corresponding code in the target simulation language GPSS/PC. Author

N89-15572*# Oxford Univ. (England).
OBJECT ORIENTED STUDIES INTO ARTIFICIAL SPACE DEBRIS
J. M. Adamson and G. Marshall *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 163-171 Prepared in cooperation with Marshall (G.), Eastleigh (England) (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

A prototype simulation is being developed under contract to the Royal Aerospace Establishment (RAE), Farnborough, England, to assist in the discrimination of artificial space objects/debris. The methodology undertaken has been to link Object Oriented programming, intelligent knowledge based system (IKBS) techniques and advanced computer technology with numeric analysis to provide a graphical, symbolic simulation. The objective is to provide an additional layer of understanding on top of conventional classification methods. Use is being made of object and rule based knowledge representation, multiple reasoning, truth maintenance and uncertainty. Software tools being used include Knowledge Engineering Environment (KEE) and SymTactics for knowledge representation. Hooks are being developed within the SymTactics framework to incorporate mathematical models describing orbital motion and fragmentation. Penetration and structural analysis can also be incorporated. SymTactics is an Object Oriented discrete event simulation tool built as a domain specific extension to the KEE environment. The tool provides facilities for building, debugging and monitoring dynamic (military) simulations. Author

N89-15573*# Alabama Univ., Huntsville. Dept. of Computer Science.
EXTENDING THE DATA DICTIONARY FOR DATA/KNOWLEDGE MANAGEMENT **c82**
Cecile L. Hydrick and Sara J. Graves *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 173-181 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 05B

Current relational database technology provides the means for efficiently storing and retrieving large amounts of data. By combining techniques learned from the field of artificial intelligence with this technology, it is possible to expand the capabilities of such systems. This paper suggests using the expanded domain concept, an object-oriented organization, and the storing of knowledge rules within the relational database as a solution to the unique problems associated with CAD/CAM and engineering data. Author

N89-15574*# Martin Marietta Aerospace, New Orleans, LA. Manned Space Systems.
CASE-BASED REASONING: THE MARRIAGE OF KNOWLEDGE BASE AND DATA BASE **c82**
Kirt Pulaski and Cyprian Casadaban *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 183-190 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 05B

The coupling of data and knowledge has a synergistic effect when building an intelligent data base. The goal is to integrate the data and knowledge almost to the point of indistinguishability, permitting them to be used interchangeably. Examples given in this paper suggest that Case-Based Reasoning is a more integrated way to link data and knowledge than pure rule-based reasoning. Author

N89-15575*# Lockheed Missiles and Space Co., Austin, TX. Artifical Intelligence Center.
EXPERT SYSTEM VALIDATION IN PROLOG Abstract Only
Todd Stock, Rolf Stachowitz, Chin-Liang Chang, and Jacqueline Combs *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 191 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

An overview of the Expert System Validation Assistant (EVA) is being implemented in Prolog at the Lockheed AI Center. Prolog was chosen to facilitate rapid prototyping of the structure and logic checkers and since February 1987, we have implemented code to check for irrelevance, subsumption, duplication, deadends, unreachability, and cycles. The architecture chosen is extremely flexible and expansible, yet concise and complementary with the normal interactive style of Prolog. The foundation of the system is in the connection graph representation. Rules and facts are modeled as nodes in the graph and arcs indicate common patterns between rules. The basic activity of the validation system is then a traversal of the connection graph, searching for various patterns the system recognizes as erroneous. To aid in specifying these patterns, a metalanguage is developed, providing the user with the basic facilities required to reason about the expert system. Using the metalanguage, the user can, for example, give the Prolog inference engine the goal of finding inconsistent conclusions among the rules, and Prolog will search the graph intantiations which can match the definition of inconsistency. Examples of code for some of the checkers are provided and the algorithms explained. Technical highlights include automatic construction of a connection graph, demonstration of the use of metalanguage, the A* algorithm modified to detect all unique cycles, general-purpose stacks in Prolog, and a general-purpose database browser with pattern completion. Author

N89-15576*# Rockwell International Corp., Seal Beach, CA. Satellite and Space Electronics Div.
EXPERT SYSTEM FOR ON-BOARD SATELLITE SCHEDULING AND CONTROL **c18**
John M. Barry and Charisse Sary *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 193-203 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 22B

An Expert System is described which Rockwell Satellite and Space Electronics Division (S&SED) is developing to dynamically schedule the allocation of on-board satellite resources and activities. This expert system is the Satellite Controller. The resources to be scheduled include power, propellant and recording tape. The activities controlled include scheduling satellite functions such as sensor checkout and operation. The scheduling of these resources and activities is presently a labor intensive and time consuming ground operations task. Developing a schedule requires

extensive knowledge of the system and subsystems operations, operational constraints, and satellite design and configuration. This scheduling process requires highly trained experts anywhere from several hours to several weeks to accomplish. The process is done through brute force, that is examining cryptic mnemonic data off line to interpret the health and status of the satellite. Then schedules are formulated either as the result of practical operator experience or heuristics - that is rules of thumb. Orbital operations must become more productive in the future to reduce life cycle costs and decrease dependence on ground control. This reduction is required to increase autonomy and survivability of future systems. The design of future satellites require that the scheduling function be transferred from ground to on board systems. Author

N89-15577*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
DYPAS: A DYNAMIC PAYLOAD SCHEDULER FOR SHUTTLE MISSIONS Abstract Only
Stephen Davis (Alabama Univ., Huntsville.) *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 205 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

Decision and analysis systems have had broad and very practical application areas in the human decision making process. These software systems range from the help sections in simple accounting packages, to the more complex computer configuration programs. Dypas is a decision and analysis system that aids prelaunch shuttle scheduling, and has added functionality to aid the rescheduling done in flight. Dypas is written in Common Lisp on a Symbolics Lisp machine. Dypas differs from other scheduling programs in that it can draw its knowledge from different rule bases and apply them to different rule interpretation schemes. The system has been coded with Flavors, an object oriented extension to Common Lisp on the Symbolics hardware. This allows implementation of objects (experiments) to better match the problem definition, and allows a more coherent solution space to be developed. Dypas was originally developed to test a programmer's aptitude toward Common Lisp and the Symbolics software environment. Since then the system has grown into a large software effort with several programmers and researchers thrown into the effort. Dypas is currently using two expert systems and three inferencing procedures to generate a many object schedule. The paper will review the abilities of Dypas and comment on its functionality. Author

N89-15578*# Alabama Univ., Huntsville. Dept. of MIS/MSC.
A KNOWLEDGE-BASED DECISION SUPPORT SYSTEM FOR PAYLOAD SCHEDULING c81
Rajesh Tyagi and Fan T. Tseng *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 207-210 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 05A

This paper presents the development of a prototype Knowledge-based Decision Support System, currently under development, for scheduling payloads/experiments on space station missions. The DSS is being built on Symbolics, a Lisp machine, using KEE, a commercial knowledge engineering tool. Author

N89-15579*# Case Western Reserve Univ., Cleveland, OH. Dept. of Computer Engineering and Science.
A CLIPS PROTOTYPE FOR AUTONOMOUS POWER SYSTEM CONTROL c20
James M. Vezina and Leon Sterling *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 211-220 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 21H

The model of the system assumes a constant power source and loads (experiments) whose power demands exceed the supply. Experiments are described by their name, power consumption, time for a complete run, present status and the state of the load. The power consumption of each load is set at a constant level but can be dynamically modified by the operator. The status specifies if the experiment is running, paused, completed or failed. The state compensates for the lack of actual feedback sensor data, by signifying the stability of the load. Experiments are scheduled to keep as many running as possible with the current system limitations. A graphics oriented user interface is embedded into the rule-based system to enable an operator to easily experiment with the system. Author

N89-15580*# Loda (Antonio G.), Huntsville, AL.
A HARDWARE IMPLEMENTATION OF A RELAXATION ALGORITHM TO SEGMENT IMAGES
Antonio G. Loda and Heggere S. Ranganath (Alabama Univ., Huntsville.) *In* NASA, Marshall Space Flight Center, Fourth Confnce on Artificial Intelligence for Space Applications Oct. 1988 p 221-229 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

Relaxation labelling is a mathematical technique frequently applied in image processing algorithms. In particular, it is extensively used for the purpose of segmenting images. The paper presents a hardware implementation of a segmentation algorithm, for images consisting of two regions, based on relaxation labelling. The algorithm determines, for each pixel, the probability that it should be labelled as belonging to a particular region, for all regions in the image. The label probabilities (labellings) of every pixel are iteratively updated, based on those of the pixel's neighbors, until they converge. The pixel is then assigned to the region correspondent to the maximum label probability. The system consists of a control unit and of a pipeline of segmentation stages. Each segmentation stage emulates in the hardware an iteration of the relaxation algorithm. The design of the segmentation stage is based on commercially available digital signal processing integrated circuits. Multiple iterations are accomplished by stringing stages together or by looping the output of a stage, or string of stages, to its input. The system interfaces with a generic host computer. Given the modularity of the architecture, performance can be enhanced by merely adding segmentation stages. Author

N89-15581*# Minnesota Univ., Minneapolis. Dept. of Computer Science.
USING AGNESS (A GENERALIZED NETWORK-BASED EXPERT SYSTEM SHELL) FOR MATCHING IMAGES Abstract Only
Ting-Chuen Pong, Chung-Mong Lee, and James Slagle *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 231 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

The image correspondence problem is considered the most difficult step in both stereo and motion analysis. Stereo vision is useful in determining the 3-D positions of points on visible surface in a scene. Motion analysis is useful in determining the spatial and temporal relationships of objects in an environment. Besides stereo and motion analysis, there is the image correspondence problem. Most of this work is based on point or local area properties of the observed gray level values in 2-D images. A global and general approach to this problem is described by using a knowledge-based system. The knowledge it uses consists of both physical properties and spatial relationships of the edges and regions extracted from the given images. The physical component depends on features of the edge or region) in isolation. The spatial component involves the set of edges and regions adjacent to a given edge (or region) of the first image and the set of edges and regions adjacent to each potentially matching edge (or region) of the second image; thus the spatial context of each edge or region is considered. A computational network is used to represent this knowledge, it allows the computation of the likelihood of matching two edges or regions with logical and heuristic operators. An expert system shell called AGNESS (A Generalized

Network-based Expert System Shell) is used to build a prototype system. Author

N89-15582*# Tennessee Univ., Knoxville. Dept. of Electrical and Computer Engineering.

AUTOMATIC INSPECTION OF ANALOG AND DIGITAL METERS IN A ROBOT VISION SYSTEM **c37**

Mohan M. Trivedi, Suresh Marapane, and ChuXin Chen *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 233-242 (For primary document see N89-15549 07-61)

(Contract DE-FG02-86NE-31968)

Avail: NTIS HC A21/MF A01 CSCL 13I

A critical limitation of most of the robots utilized in industrial environments arises due to their inability to utilize sensory feedback. This forces robot operation into totally preprogrammed or teleoperation modes. In order to endow the new generation of robots with higher levels of autonomy techniques for sensing of their work environments and for accurate and efficient analysis of the sensory data must be developed. In this paper detailed development of vision system modules for inspecting various types of meters, both analog and digital, encountered in a robotic inspection and manipulation tasks are described. These modules are tested using industrial robots having multisensory input capability. Author

N89-15583*# Vanderbilt Univ., Nashville, TN. Dept. of Electrical Engineering.

KNOWLEDGE-BASED APPROACH TO SYSTEM INTEGRATION Abstract Only

W. Blokland, C. Krishnamurthy, C. Biegl, and J. Sztipanovits *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 243 (For primary document see N89-15549 07-61)

Avail: NTIS HC A21/MF A01 CSCL 09B

To solve complex problems one can often use the decomposition principle. However, a problem is seldom decomposable into completely independent subproblems. System integration deals with problem of resolving the interdependencies and the integration of the subsolutions. A natural method of decomposition is the hierarchical one. High-level specifications are broken down into lower level specifications until they can be transformed into solutions relatively easily. By automating the hierarchical decomposition and solution generation an integrated system is obtained in which the declaration of high level specifications is enough to solve the problem. We offer a knowledge-based approach to integrate the development and building of control systems. The process modeling is supported by using graphic editors. The user selects and connects icons that represent subprocesses and might refer to prewritten programs. The graphical editor assists the user in selecting parameters for each subprocess and allows the testing of a specific configuration. Next, from the definitions created by the graphical editor, the actual control program is built. Fault-diagnosis routines are generated automatically as well. Since the user is not required to write program code and knowledge about the process is present in the development system, the user is not required to have expertise in many fields. Author

N89-15584*# Rockwell International Corp., Downey, CA. Space Transportation Systems Div.

SUCCESSFUL EXPERT SYSTEMS FOR SPACE SHUTTLE PAYLOAD INTEGRATION **c18**

Keith Morris *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 245-252 (For primary document see N89-15549 07-61)

Avail: NTIS HC A21/MF A01 CSCL 22B

Expert systems are successfully applied to solve recurring NASA Space Shuttle orbiter payload integration problems. Recurrence of these problems is the result of each Space Shuttle mission being unique. The NASA Space Shuttle orbiter was designed to be extremely flexible in its ability to handle many types and combinations of satellites and experiments. This flexibility results in different and unique engineering resource requirements for each of the payload satellites and experiments. The first successful expert system to be applied to these problems was the Orbiter Payload Bay Cabling Expert System (EXCABL), developed at Rockwell International Space Transportation Systems Division. The operational version of EXCABL was delivered in 1986 and successfully solved the payload electrical support services cabling layout problem. As a result of this success, a second expert system, Expert Drawing Matching System (EXMATCH), was developed to generate a list of the reusable installation drawings available for each EXCABL solution. EXMATCH went operational in 1987. As a result of these initial successes, the need for a third expert system was defined and is awaiting development. This new Expert System, called Technical Order Listing Expert System (EXTOL), will generate a list of all the applicable reusable installation drawings available to support the total payload bay mission provisioning and installation effort. This paper describes these expert systems, the individual problems that they were designed to solve, their individual solutions, and the degree of success achieved. These expert systems' instantiate the applicability of this technology to the solution of real-world Space Shuttle payload integration problems. Author

N89-15585*# Prospective Computer Analysts, Inc., Arlington, VA.

AUTOMATED KNOWLEDGE BASE DEVELOPMENT FROM CAD/CAE DATABASES **c82**

R. Glenn Wright and Mary Blanchard *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 253-260 (For primary document see N89-15549 07-61)

Avail: NTIS HC A21/MF A01 CSCL 05B

Knowledge base development requires a substantial investment in time, money, and resources in order to capture the knowledge and information necessary for anything other than trivial applications. This paper addresses a means to integrate the design and knowledge base development process through automated knowledge base development from CAD/CAE databases and files. Benefits of this approach include the development of a more efficient means of knowledge engineering, resulting in the timely creation of large knowledge based systems that are inherently free of error. Author

N89-15586*# Sydney Univ. (Australia). Dept. of Computer Science.

DYNAMIC REASONING IN A KNOWLEDGE-BASED SYSTEM

Anand S. Rao and Norman Y. Foo *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 261-270 (For primary document see N89-15549 07-61)

Avail: NTIS HC A21/MF A01 CSCL 09B

Any space based system, whether it is a robot arm assembling parts in space or an onboard system monitoring the space station, has to react to changes which cannot be foreseen. As a result, apart from having domain-specific knowledge as in current expert systems, a space based AI system should also have general principles of change. This paper presents a modal logic which can not only represent change but also reason with it. Three primitive operations, expansion, contraction and revision are introduced and axioms which specify how the knowledge base should change when the external world changes are also specified. Accordingly the notion of dynamic reasoning is introduced, which unlike the existing forms of reasoning, provide general principles of change. Dynamic reasoning is based on two main principles, namely minimize change and maximize coherence. A possible-world semantics which incorporates the above two principles is also discussed. The paper concludes by discussing how the dynamic reasoning system can be used to specify actions and hence form an integral part of an autonomous reasoning and planning system. Author

N89-15587*# Missouri Univ., Rolla. Graduate Engineering Center.
STRATEGIES FOR ADDING ADAPTIVE LEARNING MECHANISMS TO RULE-BASED DIAGNOSTIC EXPERT SYSTEMS
D. C. StClair, C. L. Sabharwal, W. E. Bond, and Keith Hacke (McDonnell-Douglas Research Labs., St. Louis, MO.) *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 271-279 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

Rule-based diagnostic expert systems can be used to perform many of the diagnostic chores necessary in today's complex space systems. These expert systems typically take a set of symptoms as input and produce diagnostic advice as output. The primary objective of such expert systems is to provide accurate and comprehensive advice which can be used to help return the space system in question to nominal operation. The development and maintenance of diagnostic expert systems is time and labor intensive since the services of both knowledge engineer(s) and domain expert(s) are required. The use of adaptive learning mechanisms to increment evaluate and refine rules promises to reduce both time and labor costs associated with such systems. This paper describes the basic adaptive learning mechanisms of strengthening, weakening, generalization, discrimination, and discovery. Next basic strategies are discussed for adding these learning mechanisms to rule-based diagnostic expert systems. These strategies support the incremental evaluation and refinement of rules in the knowledge base by comparing the set of advice given by the expert system (A) with the correct diagnosis (C). Techniques are described for selecting those rules in the in the knowledge base which should participate in adaptive learning. The strategies presented may be used with a wide variety of learning algorithms. Further, these strategies are applicable to a large number of rule-based diagnostic expert systems. They may be used to provide either immediate or deferred updating of the knowledge base. Author

N89-15588*# Boeing Co., Seattle, WA. Electronics.
AN ARCHITECTURE FOR AN AUTONOMOUS LEARNING ROBOT **c63**
Brian Tillotson *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 281-288 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

An autonomous learning device must solve the example bounding problem, i.e., it must divide the continuous universe into discrete examples from which to learn. We describe an architecture which incorporates an example bounder for learning. The architecture is implemented in the GPAL program. An example run with a real mobile robot shows that the program learns and uses new causal, qualitative, and quantitative relationships. Author

N89-15589*# Alberta Univ., Edmonton. Dept. of Computing Science.
TOWARD A COMPUTATIONAL THEORY FOR MOTION UNDERSTANDING: THE EXPERT ANIMATORS MODEL **c63**
Ahmed S. Mohamed and William W. Armstrong *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applicatins Oct. 1988 p 289-302 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

Artificial intelligence researchers claim to understand some aspect of human intelligence when their model is able to emulate it. In the context of computer graphics, the ability to go from motion representation to convincing animation should accordingly be treated not simply as a trick for computer graphics programmers but as important epistemological and methodological goal. In this paper we investigate a unifying model for animating a group of articulated bodies such as humans and robots in a three-dimensional environment. The proposed model is considered in the framework of knowledge representation and processing, with special reference to motion knowledge. The model is meant to help setting the basis for a computational theory for motion understanding applied to articulated bodies. Author

N89-15590*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
GRAPHIC SIMUALTION TEST BED FOR ROBOTICS APPLICATIONS IN A WORKSTATION ENVIRONMENT
J. Springfield, A. Mutammara, G. Karsai, G. E. Cook, J. Sztipanovits (Vanderbilt Univ., Nashville, TN.), and K. Fernandez *In its* Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 303-312 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

Graphical simulation is a cost-effective solution for developing and testing robots and their control systems. The availability of various high-performance workstations makes these systems feasible. Simulation offers preliminary testing of systems before their actual realizations, and it provides a framework for developing new control and planning algorithms. On the other hand, these simulation systems have to have the capability of incorporating various knowledge-based system components, e.g., task planners, representation formalisms, etc. They also should have an appropriate user interface, which makes possible the creation and control of simulation models. ROBOSIM was developed jointly by MSFC and Vanderbilt University, first in a VAX environment. Recently, the system has been ported to an HP-9000 workstation equipped with an SRX graphics accelerator. The user interface of the system now contains a menu- and icon-based facility, as well as the original ROBOSIM language. The system is also coupled to a symbolic computing system based on Common Lisp, where knowledge-based functionalities are implemented. The knowledge-based layer uses various representation and reasoning facilities for programming and testing the control systems of robots. Author

N89-15591*# Arizona Univ., Tucson. Dept. of Electrical and Computer Engineering.
DESIGN OF A SIMULATION ENVIRONMENT FOR LABORATORY MANAGEMENT BY ROBOT ORGANIZATIONS **c81**
Bernard P. Zeigler, Francois E. Cellier, and Jerzy W. Rozenblit *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 313-321 (For primary document see N89-15549 07-61)
(Contract NCC2-525)
Avail: NTIS HC A21/MF A01 CSCL 05A

This paper describes the basic concepts needed for a simulation environment capable of supporting the design of robot organizations for managing chemical, or similar, laboratories on the planned U.S. Space Station. The environment should facilitate a thorough study of the problems to be encountered in assigning the responsibility of managing a non-life-critical, but mission valuable, process to an organized group of robots. In the first phase of the work, we seek to employ the simulation environment to develop robot cognitive systems and strategies for effective multi-robot management of chemical experiments. Later phases will explore human-robot interaction and development of robot autonomy. Author

N89-15592*# Alabama Univ., Huntsville. Dept. of Computer Science.
EXPLANATION PRODUCTION BY EXPERT PLANNERS
Susan Bridges and James D. Jhannes *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 323-330 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

Although the explanation capability of expert systems is usually listed as one of the distinguishing characteristics of these systems, the explanation facilities of most existing systems are quite primitive. Computer generated explanations are typically produced from

canned text or by direct translation of the knowledge structures. Explanations produced in this manner bear little resemblance to those produced by humans for similar tasks. The focus of our research in explanation is the production of justifications for decisions by expert planning systems. An analysis of justifications written by people for planning tasks has been taken as the starting point. The purpose of this analysis is two-fold. First, analysis of the information content of the justifications will provide a basis for deciding what knowledge must be represented if human-like justifications are to be produced. Second, an analysis of the textual organization of the justifications will be used in the development of a mechanism for selecting and organizing the knowledge to be included in a computer-produced explanation. This paper describes a preliminary analysis done of justifications written by people for a planning task. It is clear that these justifications differ significantly from those that would be produced by an expert system by tracing the firing of production rules. The results from the text analysis have been used to develop an augmented phrase structured grammar (APSG) describing the organization of the justifications. The grammar was designed to provide a computationally feasible method for determining textual organization that will allow the necessary information to be communicated in a cohesive manner. Author

N89-15593*# Alabama Univ., Huntsville. Dept. of Computer Science.

KNOWLEDGE REPRESENTATION ISSUES FOR EXPLAINING PLANS

Mary Ellen Prince and James D. Johannes *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 331-340 (For primary document see N89-15549 07-61)

Avail: NTIS HC A21/MF A01 CSCL 09B

Explanations are recognized as an important facet of intelligent behavior. Unfortunately, expert systems are currently limited in their ability to provide useful, intelligent justifications of their results. We are currently investigating the issues involved in providing explanation facilities for expert planning systems. This investigation addresses three issues: knowledge content, knowledge representation, and explanation structure. Author

N89-15594*# Alabama Univ., Huntsville. Research Center-Philosophy.

SIMPLE EXPLANATIONS AND REASONING: FROM PHILOSOPHY OF SCIENCE TO EXPERT SYSTEMS

Daniel Rochowiak *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 341-348 Presented at the AAAI Workshop on Explanation, Aug. 1988 (For primary document see N89-15549 07-61)

Avail: NTIS HC A21/MF A01 CSCL 09B

A preliminary prototype of a simple explanation system was constructed. Although the system, based on the idea of storytelling, did not incorporate all of the principles of simple explanation, it did demonstrate the potential of the approach. The system incorporated a hypertext system, an inference engine, and facilities for constructing contrast type explanations. The continued development of such a system should prove to be valuable. By extending the resources of the expert system paradigm, the knowledge engineer is not forced to learn a new set of skills, and the domain knowledge already acquired by him is not lost. Further, both the beginning user and the more advanced user can be accommodated. For the beginning user, corrective explanations and ES explanations provide facilities for more clearly understanding the way in which the system is functioning. For the more advanced user, the instance and state explanations allow him to focus on the issues at hand. The simple model of explanation attempts to exploit and show how the why and how facilities of the expert system paradigm can be extended by attending to the pragmatics of explanation and adding texture to the ordinary pattern of reasoning in a rule based system. Author

N89-15595*# Technical Univ. of Denmark, Copenhagen. Electromagnetics Inst.

CONTROLLING BASINS OF ATTRACTION IN A NEURAL NETWORK-BASED TELEMETRY MONITOR **c17**

Benjamin Bell and James L. Eilbert (Grumman Aerospace Corp., Bethpage, NY.) *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 349-355 (For primary document see N89-15549 07-61)

Avail: NTIS HC A21/MF A01 CSCL 09F

The size of the basins of attraction around fixed points in recurrent neural nets (NNs) can be modified by a training process. Controlling these attractive regions by presenting training data with various amount of noise added to the prototype signal vectors is discussed. Application of this technique to signal processing results in a classification system whose sensitivity can be controlled. This new technique is applied to the classification of temporal sequences in telemetry data. Author

N89-15596*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

AN EXPERT SYSTEM FOR SATELLITE AND INSTRUMENT DATA ANOMALY AND FAULT ISOLATION **c19**

Carl Busse *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 356-367 (For primary document see N89-15549 07-61)

Avail: NTIS HC A21/MF A01 CSCL 14B

A prototype Generic Payload Operations Control System (GPOCC) is being developed at the NASA Jet Propulsion Laboratory to provide a low-cost command and control processing center for science instruments and small payloads. The GPOCC supports the difficult transition from integration and test to flight operations. The prototype will incorporate four expert systems to perform telemetry, command, and mission planning functions as well as telecommunications scheduling. The first of these expert systems to be developed will perform telemetry data analysis and fault isolation, as well as propose corrective action. This Data Analysis Module (DAM) will monitor telemetry data and perform continual data monitoring and trend analysis based on a knowledge base and historic data archived on an optical disk storage device. The system maintains a continuous knowledge database of past system performance characteristics. The goal of the Data Analysis Module is to achieve consistent, dependable and validatable performance, to demonstrate thorough, reliable and fast reasoning, and to reduce the concentration demanded of flight analysis personnel. Author

N89-15597*# Lockheed Missiles and Space Co., Menlo Park, CA. Artificial Intelligence Center.

A MULTIPROCESSING ARCHITECTURE FOR REAL-TIME MONITORING Abstract Only **c60**

James L. Schmidt, Simon M. Kao, Jackson Y. Read, Scott M. Weitzenkamp, and Thomas J. Laffey *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 369 (For primary document see N89-15549 07-61)

Avail: NTIS HC A21/MF A01 CSCL 09B

A multitasking architecture for performing real-time monitoring and analysis using knowledge-based problem solving techniques is described. To handle asynchronous inputs and perform in real time, the system consists of three or more distributed processes which run concurrently and communicate via a message passing scheme. The Data Management Process acquires, compresses, and routes the incoming sensor data to other processes. The Inference Process consists of a high performance inference engine that performs a real-time analysis on the state and health of the physical system. The I/O Process receives sensor data from the Data Management Process and status messages and recommendations from the Inference Process, updates its graphical displays in real time, and acts as the interface to the console operator. The distributed architecture has been interfaced to an actual spacecraft (NASA's Hubble Space Telescope) and is able to process the incoming telemetry in real-time (i.e., several hundred

data changes per second). The system is being used in two locations for different purposes: (1) in Sunnyville, California at the Space Telescope Test Control Center it is used in the preflight testing of the vehicle; and (2) in Greenbelt, Maryland at NASA/Goddard it is being used on an experimental basis in flight operations for health and safety monitoring. Author

N89-15598*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
PI-IN-A-BOX: INTELLIGENT ONBOARD ASSISTANCE FOR SPACEBORNE EXPERIMENTS IN VESTIBULAR PHYSIOLOGY **c60**
Silvano Colombano, Laurence Young, Nancy Wogrin (Stanford Univ., CA.), and Don Rosenthal *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 371-380 Prepared in cooperation with Digital Equipment Corp., Palo Alto, CA (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

In construction is a knowledge-based system that will aid astronauts in the performance of vestibular experiments in two ways: it will provide real-time monitoring and control of signals and it will optimize the quality of the data obtained, by helping the mission specialists and payload specialists make decisions that are normally the province of a principal investigator, hence the name PI-in-a-box. An important and desirable side-effect of this tool will be to make the astronauts more productive and better integrated members of the scientific team. The vestibular experiments are planned by Prof. Larry Young of MIT, whose team has already performed similar experiments in Spacelab missions SL-1 and D-1, and has experiments planned for SLS-1 and SLS-2. The knowledge-based system development work, performed in collaboration with MIT, Stanford University, and the NASA-Ames Research Center, addresses six major related functions: (1) signal quality monitoring; (2) fault diagnosis; (3) signal analysis; (4) interesting-case detection; (5) experiment replanning; and (6) integration of all of these functions within a real-time data acquisition environment. Initial prototyping work has been done in functions (1) through (4). Author

N89-15599*# Rockwell International Corp., Downey, CA. SBI Software Engineering.
ARTIFICIAL INTELLIGENCE APPLICATIONS IN SPACE AND SDI: A SURVEY **c63**
Harvey E. Fiala *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 381-390 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

The purpose of this paper is to survey existing and planned Artificial Intelligence (AI) applications to show that they are sufficiently advanced for 32 percent of all space applications and SDI (Space Defense Initiative) software to be AI-based software. To best define the needs that AI can fill in space and SDI programs, this paper enumerates primary areas of research and lists generic application areas. Current and planned NASA and military space projects in AI will be reviewed. This review will be largely in the selected area of expert systems. Finally, direct applications of AI to SDI will be treated. The conclusion covers the importance of AI to space and SDI applications, and conversely, their importance to AI. Author

N89-15600*# Titan Systems, Inc., Gardena, CA.
CONCEPTS FOR AUTONOMOUS FLIGHT CONTROL FOR A BALLOON ON MARS **c08**
Thomas F. Heinsheimer, Robyn C. Friend, and Neil G. Siegel (Siegel, Neil G., Redondo Beach, CA) *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 391-400 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 01A

Balloons operating as airborne rovers have been suggested as ideal candidates for early exploration of the Martian surface. An international study team composed of scientists from the U.S.S.R., France, and the U.S.A. is planning the launching in 1994 of a balloon system to fly on Mars. The current likely design is a dual thermal/gas balloon that consists of a gas balloon suspended above a solar-heated thermal balloon. At night, the thermal balloon provides no lift, and the balloon system drifts just above the Martian surface; the lift of the gas balloon is just sufficient to prevent the science payload from hitting the ground. During the day, the balloon system flies at an altitude of 4 to 5 kilometers, rising due to the added lift provided by the thermal balloon. Over the course of a single Martian day, there may be winds in several directions, and in fact it can be expected that there will be winds simultaneously in different directions at different altitudes. Therefore, a balloon system capable of controlling its own altitude, via an autonomous flight control system, can take advantage of these different winds to control its direction, thereby greatly increasing both its mission utility and its longevity. Author

N89-15601*# Colorado State Univ., Fort Collins. Dept. of Computer Science.
A VERY LARGE AREA NETWORK (VLAN) KNOWLEDGE-BASE APPLIED TO SPACE COMMUNICATION PROBLEMS **c32**
Carol S. Zander *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 401-409 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 17B

This paper first describes a hierarchical model for very large area networks (VLAN). Space communication problems whose solution could profit by the model are discussed and then an enhanced version of this model incorporating the knowledge needed for the missile detection-destruction problem is presented. A satellite network or VLAN is a network which includes at least one satellite. Due to the complexity, a compromise between fully centralized and fully distributed network management has been adopted. Network nodes are assigned to a physically localized group, called a partition. Partitions consist of groups of cell nodes with one cell node acting as the organizer or master, called the Group Master (GM). Coordinating the group masters is a Partition Master (PM). Knowledge is also distributed hierarchically existing in at least two nodes. Each satellite node has a back-up earth node. Knowledge must be distributed in such a way so as to minimize information loss when a node fails. Thus the model is hierarchical both physically and informationally. Author

N89-15602*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
Ada IN AI OR AI IN Ada. ON DEVELOPING A RATIONALE FOR INTEGRATION
Philippe E. Collard (California Univ., San Diego, La Jolla.) and Andre Goforth *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 411-419 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

The use of Ada as an Artificial Intelligence (AI) language is gaining interest in the NASA Community, i.e., by parties who have a need to deploy Knowledge Based-Systems (KBS) compatible with the use of Ada as the software standard for the Space Station. A fair number of KBS and pseudo-KBS implementations in Ada exist today. Currently, no widely used guidelines exist to compare and evaluate these with one another. The lack of guidelines illustrates a fundamental problem inherent in trying to compare and evaluate implementations of any sort in languages that are procedural or imperative in style, such as Ada, with those in languages that are functional in style, such as Lisp. Discussed are the strengths and weakness of using Ada as an AI language and a preliminary analysis provided of factors needed for the development of criteria for the integration of these two families of languages and the environments in which they are implemented. The intent for developing such criteria is to have a logical rationale that may be used to guide the development of Ada tools and

methodology to support KBS requirements, and to identify those AI technology components that may most readily and effectively be deployed in Ada. Author

N89-15603*# General Electric Co., Philadelphia, PA.
AUTOMATIC SCHEDULING AND PLANNING (ASAP) IN FUTURE GROUND CONTROL SYSTEMS **c81**
Sam Matlin *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 421-430 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 05A

This report describes two complementary approaches to the problem of space mission planning and scheduling. The first is an Expert System or Knowledge-Based System for automatically resolving most of the activity conflicts in a candidate plan. The second is an Interactive Graphics Decision Aid to assist the operator in manually resolving the residual conflicts which are beyond the scope of the Expert System. The two system designs are consistent with future ground control station activity requirements, support activity timing constraints, resource limits and activity priority guidelines. Author

N89-15604*# Carleton Univ., Ottawa (Ontario). School of Computer Science.
A DYNAMIC CASE-BASED PLANNING SYSTEM FOR SPACE STATION APPLICATION **c81**
F. Oppacher and D. Deugo *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 431-439 Sponsored in part by the Canadian Space Station Program Office of the National Research Council (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 05A

We are currently investigating the use of a case-based reasoning approach to develop a dynamic planning system. The dynamic planning system (DPS) is designed to perform resource management, i.e., to efficiently schedule tasks both with and without failed components. This approach deviates from related work on scheduling and on planning in AI in several aspects. In particular, an attempt is made to equip the planner with an ability to cope with a changing environment by dynamic replanning, to handle resource constraints and feedback, and to achieve some robustness and autonomy through plan learning by dynamic memory techniques. We briefly describe the proposed architecture of DPS and its four major components: the PLANNER, the plan EXECUTOR, the dynamic REPLANNER, and the plan EVALUATOR. The planner, which is implemented in Smalltalk, is being evaluated for use in connection with the Space Station Mobile Service System (MSS). Author

N89-15605*# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil). Computing and Applied Mathematics Lab.
TOWARDS A KNOWLEDGE-BASED SYSTEM TO ASSIST THE BRAZILIAN DATA-COLLECTING SYSTEM OPERATION **c82**
Valter Rodrigues, P. O. Simoni, P. P. B. Oliveira, C. A. Oliveira, and C. A. M. Nogueira *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 441-449 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 05B

A study is reported which was carried out to show how a knowledge-based approach would lead to a flexible tool to assist the operation task in a satellite-based environmental data collection system. Some characteristics of a hypothesized system comprised of a satellite and a network of Interrogable Data Collecting Platforms (IDCPs) are pointed out. The Knowledge-Based Planning Assistant System (KBPAS) and some aspects about how knowledge is organized in the IDCP's domain are briefly described. Author

N89-15606*# Furman Univ., Greenville, SC.
USE OF AN EXPERT SYSTEM DATA ANALYSIS MANAGER FOR SPACE SHUTTLE MAIN ENGINE TEST EVALUATION **c20**
Ken Abernethy *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 451-456 (For primary document see N89-15549 07-61)
(Grant NAG8-646)
Avail: NTIS HC A21/MF A01 CSCL 21H

The ability to articulate, collect, and automate the application of the expertise needed for the analysis of space shuttle main engine (SSME) test data would be of great benefit to NASA liquid rocket engine experts. This paper describes a project whose goal is to build a rule-based expert system which incorporates such expertise. Experiential expertise, collected directly from the experts currently involved in SSME data analysis, is used to build a rule base to identify engine anomalies similar to those analyzed previously. Additionally, an alternate method of expertise capture is being explored. This method would generate rules inductively based on calculations made using a theoretical model of the SSME's operation. The latter rules would be capable of diagnosing anomalies which may not have appeared before, but whose effects can be predicted by the theoretical model. Author

N89-15607*# Aerospace Corp., Los Angeles, CA. Space Sciences Lab.
SPACECRAFT ENVIRONMENTAL ANOMALIES EXPERT SYSTEM **c18**
H. C. Koons and D. J. Gorney *In* NASA, Marshall Space Flight Center, Foruth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 457-465 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 22B

A microcomputer-based expert system is being developed at the Aerospace Corporation Space Sciences Laboratory to assist in the diagnosis of satellite anomalies caused by the space environment. The expert system is designed to address anomalies caused by surface charging, bulk charging, single event effects and total radiation dose. These effects depend on the orbit of the satellite, the local environment (which is highly variable), the satellite exposure time and the hardness of the circuits and components of the satellite. The expert system is a rule-based system that uses the Texas Instruments Personal Consultant Plus expert system shell. The completed expert system knowledge base will include 150 to 200 rules, as well as a spacecraft attributes database, an historical spacecraft anomalies database, and a space environment database which is updated in near real-time. Currently, the expert system is undergoing development and testing within the Aerospace Corporation Space Sciences Laboratory. Author

N89-15608*# Rockwell International Corp., Huntsville, AL. Rocketdyne Div.
USING HYPERMEDIA TO DEVELOP AN INTELLIGENT TUTORIAL/DIAGNOSTIC SYSTEM FOR THE SPACE SHUTTLE MAIN ENGINE CONTROLLER LAB **c14**
Daniel OReilly, Robert Williams, and Kevin Yarborough *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 467-476 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 14B

This is a tutorial/diagnostic system for training personnel in the use of the Space Shuttle Main Engine Controller (SSMEC) Simulation Lab. It also provides a diagnostic capable of isolating lab failures at least to the major lab component. The system was implemented using Hypercard, which is an program of hypermedia running on Apple Macintosh computers. Hypercard proved to be a viable platform for the development and use of sophisticated tutorial systems and moderately capable diagnostic systems. This tutorial/diagnostic system uses the basic Hypercard tools to provide the tutorial. The diagnostic part of the system uses a simple interpreter written in the Hypercard language (Hypertalk) to implement the backward chaining rule based logic commonly found

in diagnostic systems using Prolog. Some of the advantages of Hypercard in developing this type of system include sophisticated graphics, animation, sound and voice capabilities, its ability as a hypermedia tool, and its ability to include digitized pictures. The major disadvantage is the slow execution time for evaluation of rules (due to the interpretive processing of the language). Other disadvantages include the limitation on the size of the cards, that color is not supported, that it does not support grey scale graphics, and its lack of selectable fonts for text fields. Author

N89-15609*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
OBJECT-ORIENTED FAULT TREE EVALUATION PROGRAM FOR QUANTITATIVE ANALYSES
F. A. Patterson-Hine and B. V. Koen (Texas Univ., Austin.) *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 477-485 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

Object-oriented programming can be combined with fault free techniques to give a significantly improved environment for evaluating the safety and reliability of large complex systems for space missions. Deep knowledge about system components and interactions, available from reliability studies and other sources, can be described using objects that make up a knowledge base. This knowledge base can be interrogated throughout the design process, during system testing, and during operation, and can be easily modified to reflect design changes in order to maintain a consistent information source. An object-oriented environment for reliability assessment has been developed on a Texas Instrument (TI) Explorer LISP workstation. The program, which directly evaluates system fault trees, utilizes the object-oriented extension to LISP called Flavors that is available on the Explorer. The object representation of a fault tree facilitates the storage and retrieval of information associated with each event in the tree, including tree structural information and intermediate results obtained during the tree reduction process. Reliability data associated with each basic event are stored in the fault tree objects. The object-oriented environment on the Explorer also includes a graphical tree editor which was modified to display and edit the fault trees. Author

N89-15610*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
CONSIDERATIONS IN DEVELOPMENT OF EXPERT SYSTEMS FOR REAL-TIME SPACE APPLICATIONS c81
S. Murugesan *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 487-496 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 05A

Over the years, demand on space systems has increased tremendously and this trend will continue for the near future. Enhanced capabilities of space systems, however, can only be met with increased complexity and sophistication of onboard and ground systems. Artificial Intelligence and expert system techniques have great potential in space applications. Expert systems could facilitate autonomous decision making, improve in-orbit fault diagnosis and repair, enhance performance and reduce reliance on ground support. However, real-time expert systems, unlike conventional off-line consultative systems, have to satisfy certain special stringent requirements before they could be used for onboard space applications. Challenging and interesting new environments are faced while developing expert system space applications. This paper discusses the special characteristics, requirements and typical life cycle issues for onboard expert systems. Further, it also describes considerations in design, development, and implementation which are particularly important to real-time expert systems for space applications. Author

N89-15611*# Alabama Univ., Huntsville. Research Center.
AUTOMATIC PROGRAMMING OF SIMULATION MODELS Final Report
Bernard J. Schroer, Fan T. Tseng, Shou X. Zhang, and Wen S. Dwan Sep. 1988 47 p
(Grant NAG8-641)
(NASA-CR-184573; NAS 1.26:184573; UAH-RR-725) Avail: NTIS HC A03/MF A01 CSCL 09B

The objective of automatic programming is to improve the overall environment for describing the program. This improved environment is realized by a reduction in the amount of detail that the programmer needs to know and is exposed to. Furthermore, this improved environment is achieved by a specification language that is more natural to the user's problem domain and to the user's way of thinking and looking at the problem. The goal of this research is to apply the concepts of automatic programming (AP) to modeling discrete event simulation system. Specific emphasis is on the design and development of simulation tools to assist the modeler define or construct a model of the system and to then automatically write the corresponding simulation code in the target simulation language, GPSS/PC. A related goal is to evaluate the feasibility of various languages for constructing automatic programming simulation tools. Author

N89-15612# Naval Postgraduate School, Monterey, CA.
AUTOMATED DESIGN OF A MICROPROGRAMMED CONTROLLER FOR A FINITE STATE MACHINE M.S. Thesis
James E. Harmon Jun. 1988 231 p
(AD-A200032) Avail: NTIS HC A11/MF A01 CSCL 12F

A Scalable Complementary Metal Oxide Semiconductor (SCMOS) microprogrammed controller for the Monterey Silicon Compiler (MSC) is implemented in the LISP programming language. The internal organization of MSC and the architecture of Very Large Scale Integrated (VLSI) circuits generated by MSC are discussed. GRA

N89-15613# Carnegie-Mellon Univ., Pittsburgh, PA. Robotics Inst.
END OF YEAR REPORT FOR PARALLEL VISION ALGORITHM DESIGN AND IMPLEMENTATION Technical Report, 15 Jan. 1987 - 14 Jan. 1988
Takeo Kanade and Jon A. Webb 11 Aug. 1988 84 p
(Contract DACA76-85-C-0002)
(AD-A199305; CMU-RI-TR-88-11) Avail: NTIS HC A05/MF A01 CSCL 23C

Progress on the Parallel Vision project is reported. Three major accomplishments are noted: the development of the Apply language, the WEB library, and benchmarks of Warp for the DARPA image understanding architecture comparisons. The Apply language development includes a description of the language and its implementation on Warp, the Sun, and the Hughes HBA, together with benchmark comparisons of these very different architectures. The WEB library includes over 100 routines; included in this report are performance numbers of these routines on the CMU Warp machine. Finally, a detailed analysis of the Warp routines implemented for the DARPA Image Understanding benchmarks is given. GRA

N89-15614# Battelle Columbus Labs., Research Triangle Park, NC.
AN EVALUATION OF CHARACTERISTICS CONTRIBUTING TOWARDS EASE OF USER-COMPUTER INTERFACE IN A COMPUTER-AIDED INSTRUCTION EXERCISE Final Report, Feb. - Oct. 1987
Kent E. Williams, Cheryl J. Hamel, and Lisa B. Shrestha 31 Dec. 1987 49 p
(Contract DAAL03-86-D-0001)
(AD-A199458; NTSC-TR-87-030) Avail: NTIS HC A03/MF A01 CSCL 05F

This research tests the effectiveness of the five user-computer interface principles: brevity, consistency, flexibility, compatibility, and responsiveness as proposed by Williges and Williges (1984) to facilitate user interaction with computer aided instruction. These categories were further refined by Hamel and Clark (1986) into a checklist of characteristics under each category. An experimental training program was created embedding the 53 user computer interface characteristics in computer aided instruction exercises.

Test subjects were required to run through the experimental training program and to evaluate the contribution of each characteristic to ease of interaction and training gain. Multiple regression correlation analyses were applied to the data to determine the magnitude of effect of each characteristic to ease of use. As a result of this work, a handbook describing and providing illustrative examples of characteristics was developed along with a system to score CAI exercises in terms of user computer interaction. GRA

N89-15615# Ballistic Research Labs., Aberdeen Proving Ground, MD.

A FAST DATA REDUCTION ALGORITHM FOR MULTI-FRAME PARTICLE-IMAGE VELOCIMETRY Technical Report, Dec. 1987 - Feb. 1988

B. R. Frieden and Csaba K. Zoltani Mar. 1988 25 p
(AD-A199531; BRL-TR-2905) Avail: NTIS HC A03/MF A01 CSCL 19A

An efficient tracking algorithm for the reduction and analysis of particle image velocimetry data is described. Using Fast Fourier Transforms, it is shown that one hundred identical particles performing random motions superimposed on Poiseuille flow and recorded on two successive frames may be tracked in about one minute of time on a Cyber 175 computer. The use and analysis of the signatures of light reflected by scattering sites in a moving medium has been actively pursued for the determination of flow velocities. A good overview of the subject was given by Adrian. Here we address the problem of the associated data reduction, in particular when the number of scatterers is relatively small (the order of 100), and the particles are relatively large, of the order of tens of microns; this is called particle image velocimetry (PIV). GRA

N89-15616# Army Armament Research and Development Command, Watervliet, NY.

MATHEMATICAL ASPECTS OF THE OFF-LINE PROGRAMMING OF FILAMENT WINDING MACHINES FOR GENERAL SURFACES OF REVOLUTION Final Report

Royce W. Soanes Sep. 1988 89 p
(AD-A199544; ARCCB-TR-88036) Avail: NTIS HC A05/MF A01 CSCL 12D

This report contains a reasonably complete description of the analytical, geometrical, numerical, and computational aspects of the off-line programming of a rotating-traversing composite filament winding machine for wrapping general axisymmetric surfaces of revolution. The topics addressed are geodesic winding paths, path/angle relations, quasi-geodesic paths, wrappable paths and surfaces, path behavior near turning points, a square root singularity quadrature formula, piecewise linear approximation, path computation, path/winder relations, winder data generation, time base computation, surface coverage relations, surface buildup relations, function definition, and indefinite integration. GRA

N89-15617# Argonne National Lab., IL. Mathematics and Computer Science Div.

GRAPHIES TOOLS FOR DEVELOPING HIGH-PERFORMANCE ALGORITHMS

Orlie Brewer, Jack Dongarra, David Levine, and Danny Sorensen 1988 11 p Presented at the International Meeting on Parallel Computing Methods, Algorithms, Applications, Verona, Italy, 28 Sep. 1988
(Contract W-31-109-eng-38)
(DE89-000526; CONF-8809151-1) Avail: NTIS HC A03/MF A01

This paper discusses two tools that aid in the development of parallel algorithms for high-performance computers. We describe the SCHEDULE package which provides an environment for developing and analyzing new parallel algorithms in FORTRAN that require sophisticated synchronization at a large-grain level. This package provides portability of a user's code and also has a graphics postprocessor for performance analysis and debugging. We also discuss a graphics tool useful for studying memory access patterns of algorithms. DOE

N89-15618# Argonne National Lab., IL.

HIGH LEVEL TOOLS FOR GKS GRAPHICS

Thomas G. Worlton 1988 8 p Presented at the DECUS Spring Symposium, Cincinnati, OH, 16 May 1988
(Contract W-31-109-eng-38)
(DE89-000587; CONF-880569-4) Avail: NTIS HC A02/MF A01

GKS graphics software provides a device independent method of producing graphics on a number of different devices, but it is a rather low level package which is difficult to use. The GPLOT FORTRAN library of graphics tools discussed here can be used to simplify the creation of scientific graphics with VAX GKS(GPL). GPLOT contains routines for drawing and labelling of axes for linear, log, and log-log plots. It supports the drawing of data curves with or without markers and/or error bars on the data points. It provides routines for producing a legend which automatically keeps track of the line type, color, and marker type used in producing each of the curves on a plot. There are also routines for producing contour plots, bar graphs and for drawing vectors with various types of arrow heads. GPLOT allows setting the text font by font name and attributes. It also allows the definition of switch characters to switch fonts or do subscripts and superscripts using instructions embedded in the string. GPLOT supports the GKS feature of multiple active workstations which allows creation of hardcopy plots while plotting to the screen. GPLOT supports creation of GKS metafiles and includes a program for interpreting and plotting GKS metafiles. It also supports graphics locator input with conversion of coordinates to user units if desired. To simplify user interaction during input, there are routines for switching between VT220 mode and graphics mode. A number of examples are presented. DOE

N89-15619# Oak Ridge National Lab., TN.

A PIONEERING APPLICATION OF NQA-1 QUALITY ASSURANCE STANDARDS IN THE DEVELOPMENT OF SOFTWARE

Alison N. Weisbin 1988 8 p Presented at the 4th Annual DOE Model Conference, Oak Ridge, TN, 3 Oct. 1988
(Contract DE-AC05-84OR-21400)
(DE89-000641; CONF-881054-8) Avail: NTIS HC A02/MF A01

One reason for systematically applying quality assurance to computer software is the extensive use of results from computer programs to characterize potential sited for nuclear waste repositories leading ultimately to important policy making decisions. Because data from these programs characterize the likely radioactivity profile for many hundreds of years, experimental validation is not feasible. The Sensitivity and Uncertainty Analysis Methods Development Project (SUAMDP) was developed to formulate and utilize efficient and comprehensive methods for determining sensitivities of calculated results with respect to changes in all input parameters. The computerized methodology was embodied in the Gradient Enhanced Software System (GRESS). Due to the fact that GRESS was to be used in the site characterization for waste storage, stringent NQA-1 requirements were imposed by the sponsor. A working relationship between the Oak Ridge National Laboratory (ORNL) Quality Department and the research scientists developing GRESS was essential in achieving understanding and acceptance of the quality assurance requirements as applied to the SUAMDP. The relationship resulted in the SUAMDP becoming the first software project at ORNL to develop a comprehensive NQA-1 Quality Assurance Plan; this plan now serves as a model for software quality assurance at ORNL. This paper describes the evolution of this plan and its impact on the application of quality assurance procedures to software. DOE

N89-15620# Oak Ridge National Lab., TN.

PARALLEL SPARSE GAUSSIAN ELIMINATION WITH PARTIAL PIVOTING

Alan George (Waterloo Univ., Ontario) and Edmond Ng 1988 22 p Presented at the Workshop on Supercomputers and Large-scale Optimization: Algorithms, Software, and Applications, Minneapolis, MN, 16 May 1988

(Contract DE-AC05-84OR-21400)
(DE89-000654; CONF-8805200-1) Avail: NTIS HC A03/MF A01

In this article we consider the factorization of a sparse nonsymmetric matrix using Gaussian elimination with partial pivoting on a multiprocessor having a globally-shared memory. The parallel algorithm makes use of a static data structure developed by George, Liu and Ng. Some numerical experiments on a Sequent Balance 8000 are presented to demonstrate the efficiency of the parallel implementation. DOE

N89-15621# Oak Ridge National Lab., TN.
PARALLEL SPARSE GAUSSIAN ELIMINATION WITH PARTIAL PIVOTING
A. George and Edmond Ng Oct. 1988 33 p
(Contract DE-AC05-84OR-21400)
(DE89-001170; ORNL/TM-10866) Avail: NTIS HC A03/MF A01

In this article we consider the factorization of a sparse nonsymmetric matrix using Gaussian elimination with partial pivoting on a multiprocessor having a globally-shared memory. The parallel algorithm makes use of a static data structure developed by George, Liu and Ng. Some numerical experiments on a Sequent Balance 8000 are presented to demonstrate the efficiency of the parallel implementation. DOE

N89-15622# Sandia National Labs., Albuquerque, NM.
MULTITASKING THE THREE-DIMENSIONAL SHOCK WAVE CODE CTH ON THE CRAY X-MP/416
J. M. McGlaun and S. L. Thompson 1988 15 p Presented at the Nuclear Explosives Code Developer's Conference, Boulder, CO, 11 Oct. 1988
(Contract DE-AC04-76DP-00789)
(DE89-001186; SAND-88-1598C; CONF-881093-4) Avail: NTIS HC A03/MF A01

CTH is a software system under development at Sandia National Laboratories Albuquerque that models multidimensional, multi-material, large-deformation, strong shock wave physics. CTH was carefully designed to both vectorize and multitask on the Cray X-MP/416. All of the physics routines are vectorized except the thermodynamics and the interface tracer. All of the physics routines are multitasked except the boundary conditions. The Los Alamos National Laboratory multitasking library was used for the multitasking. The resulting code is easy to maintain, easy to understand, gives the same answers as the unitasked code, and achieves a measured speedup of approximately 3.5 on the four cpu Cray. This document discusses the design, prototyping, development, and debugging of CTH. It also covers the architecture features of CTH that enhances multitasking, granularity of the tasks, and synchronization of tasks. The utility of system software and utilities such as simulators and interactive debuggers are also discussed. DOE

N89-15623*# Oak Ridge National Lab., TN.
MODELING CYCLIC MELTING AND REFREEZING IN A HOLLOW METAL CANISTER
D. G. Wilson and R. E. Flanery Sep. 1988 44 p
(Contract NASA Order C-30001-J; DE-AC05-84OR-21400)
(NASA-CR-184630; NAS 1.26:184630; DE89-001325; ORNL-6497) Avail: NTIS HC A03/MF A01 CSCL 09B

This report documents the mathematical model and computational algorithms used in a pair of computer programs that do energy redistribution calculations as part of a comprehensive simulation for thermal and structural analyses of one component of a thermal energy storage system for the manned space station. The complete problem includes cyclic melting and refreezing, fluid flow, and void formation and movement, as well as conductive and convective heat transfer in a three dimensional setting. The problem is posed in a hollow, metal canister filled with a high temperature phase change material. The heat transfer equations discussed here consist of a pair of partial differential equations for energy transfer (one linear the other mildly nonlinear), coupled with a constitutive relation for energy and temperature. This constitutes a weak, enthalpy formulation of the phase change problem. The partial differential equations are approximated by a system of coupled Crank Nicholson-type finite difference equations. These nonlinear, implicit equations are solved for enthalpy (energy content) and temperature fields simultaneously. A successive overrelaxation iteration scheme with red/black ordering is used to solve the nonlinear difference equations. The algorithms have been vectorized for rapid execution on the Cray X-MP supercomputer and techniques used to do this are discussed. DOE

N89-15624# Los Alamos National Lab., NM. Computing and Communications Div.
EXPERIENCES WITH GLOBAL OPTIMIZATION TECHNIQUES IN MASSIVELY PARALLEL PROCESSING ENVIRONMENTS
John H. Hall and Robert Hiromoto 1988 10 p Presented at the Supercomputing Conference, Orlando, FL, 14 Nov. 1988
(Contract W-7405-eng-36)
(DE88-009109; LA-UR-88-1423; CONF-881112-3) Avail: NTIS HC A02/MF A01

The modeling of many physically relevant processes involves the location of global extrema, which are often surrounded by numerous local extrema. The effort involved in locating these extrema grows rapidly with increasing dimensionality of the problems being investigated. A method of analysis for algorithms from the perspective of a parallel processing environment is developed and applied to the family of Monte Carlo global optimization schemes. A new highly parallel Monte Carlo algorithm is presented. Chaotic iteration schemes resulting in nondeterministic algorithms are discussed, and an analysis of the optimal conditions for their application to this class of problems is presented. DOE

N89-15625# Los Alamos National Lab., NM.
A SCIENTIFIC VISUALIZATION WORKBENCH
Richard L. Phillips 1988 9 p Presented at the Supercomputing Conference, Orlando, FL, 14 Nov. 1988
(Contract W-7405-eng-36)
(DE88-014397; LA-UR-88-2454; CONF-881112-4) Avail: NTIS HC A02/MF A01

A system for visualization of data from supercomputer simulations has been developed for use by scientists and engineers at Los Alamos National Laboratory. The scientific visualization workbench, as the system is called, is based on an industry standard workstation (a Sun 3/160C), the NeWS window system, and a video/graphics add-in card, which is supported by NeWS. Also involved is a frame buffer attached to a 48-Mbit/s Cray channel and a video link from the frame buffer to the Sun workstation. Computation and graphics preparation are performed on the Cray under the control of a NeWS client program. Images are rasterized and sent to the workstation at the rate of 25 frames/s. The workbench permits the scientist to converse with applications running on a Cray but still retain the convenience and flexibility of a personal workstation environment. Moreover, the video link allows animated graphics images to be displayed on the workstation at a much higher rate than possible with a conventional network connection, i.e., Ethernet. Also, NeWS affords the convenience of a modern window system. Live videos can be displayed in a window anywhere on the screen, while other windows may contain conventional text or graphics. DOE

N89-15626# Argonne National Lab., IL.
THE AURORA OR-PARALLEL PROLOG SYSTEM
Ewing Lusk, Ralph Butler, Terrence Disz, Robert Olson, Ross Overbeck, Rick Stevens, David H. D. Warren, Alan Calderwood, Peter Szeredi, and Seif Haridi (Swedish Inst. of Computer Science, Kista.) et al 1988 19 p Presented at the 5th Generation Computer Systems International Conference, Tokyo, Japan, 28 Nov. 1988
(Contract W-31-109-eng-38)
(DE89-000537; CONF-881188-1) Avail: NTIS HC A03/MF A01

Aurora is a prototype or-parallel implementation of the full Prolog language for shared-memory multiprocessors, developed as part of an informal research collaboration known as the Gigalips Project. It currently runs on Sequent and Encore machines. It has been

constructed by adapting Sicstus Prolog, an existing, portable, state-of-the-art, sequential Prolog system. The techniques for constructing a portable multiprocessor version follow those pioneered in a predecessor system, ANL-WAM. The SRI model was adopted as the means to extend the Sicstus Prolog engine for or-parallel operation. We describe the design and main implementation features of the current Aurora system, and present some preliminary experimental results. We conclude with our plans for the continued development of the system and an outline of future research directions. DOE

N89-15627# California Univ., Berkeley. Lawrence Berkeley Lab. National Center for Electron Microscopy.
ADVANCES IN HIGH-RESOLUTION IMAGE SIMULATION
Michael A. OKeefe and Roar Kilaas Sep. 1988 40 p Presented at the 6th Pfefferkorn Conference, Niagara Falls, NY, 28 Apr. 1988
(Contract DE-AC03-76SF-00098)
(DE89-000569; LBL-24727; CONF-8804206-1) Avail: NTIS HC A03/MF A01

Continuing advances in hardware and software have improved both the speed and the range of computations that can be made to simulate high resolution electron microscope (HREM) images from various structures. Use of image display systems and array processors have made the image simulation procedure much more interactive while laser printers provide a fast high-quality hard copy output. Use of array processors has enabled the rewriting of electron scattering algorithms to include convergence effects (previously only considered after the scattered electron beams had emerged from the specimen) and upper-layer-line effects. With an array processor it is faster to compute effects of spatial and temporal coherence in real space, rather than use approximation solutions derived from series expansion in reciprocal space. With a frame buffer and suitable software the use has the facility to change parameters and view the results of the change almost immediately. Selected images can then be directed to hard copy output, in contrast with batch methods where series of hard copy images are produced and then selected from. Given a microdensitometer for input of experimental images from plates, or a video camera attached to the electron microscope and a frame buffer, split screen comparisons between experimental and computed images are possible, including independent control of image contrast, magnification and orientation. DOE

N89-15628# Naval Ocean Research and Development Activity, Bay St. Louis, MS.
IMPLEMENTATION ISSUES FOR LEVEL O IMAGE PROCESSOR SOFTWARE WITHIN AN APPLICATION PACKAGE Final Report
James E. Lennox Feb. 1988 30 p
(AD-A197912; NORDA-203) Avail: NTIS HC A03/MF A01 CSCL 09B

Minimum hardware constraints and the scope of modifications necessary to implement different image processors within the Earth Resources Laboratory Applications Software (ELAS) software environment are described. The impact on software engineering principles related to the implementation of low-level software to support the imaging functions is discussed. Author

N89-15629*# Lockheed Missiles and Space Co., Huntsville, AL. Engineering Center.
LOCKHEED GRAPHICS ANALYSIS PROGRAM (LGAP) UPDATED USER'S MANUAL: ENHANCEMENT OF AERO/FLUIDS ANALYSIS SYSTEM Final Report
30 Sep. 1988 34 p
(Contract NAS8-36221)
(NASA-CR-183529; NAS 1.26:183529; LMSC-HEC-TR-F225910A) Avail: NTIS HC A03/MF A01 CSCL 09B

The objective of this study was to further develop the computational Aero/Fluids Analysis System (AFAS). The updates to this system enhance the capability of rapidly and efficiently performing aerodynamic analyses of test, flight, and theoretical data. The assessment and enhancement of the system has included documentation, training courses, and on-site instruction in use of the system by Marshall Space Flight Center (MSFC) personnel. The heart of AFAS is the Digital Equipment Corporation (DEC) VAX 11/750 computer system with appropriate hardware and software. Lockheed provided an interactive graphics analysis program to MSFC for the AFAS. This program, Lockheed Graphics Analysis Program (LGAP), and supporting utility software provides MSFC with the capability to analyze, develop, and manipulate both aerodynamic pressure data and six-component static stability data in a timely and cost effective manner. The LGAP program is an interactive computer graphics program which allows an engineer to apply his judgment to the development of pressure distributions and the smoothing of wind tunnel pressure data in a real time environment. The purpose of the program is to produce airloads which are compatible with vehicle stability data and which reflect engineering judgment. Author

N89-15630# Los Alamos National Lab., NM.
LOW DIMENSIONAL SIGMA MODELS
Wojciech J. Zakrzewski 1988 16 p Presented at the Meeting of the Division of Particles and Fields of the American Physical Society (APS), Storrs, CT, 13-18 Aug. 1988 Prepared in cooperation with Durham Univ. (England)
(Contract W-7405-eng-36)
(DE89-000362; LA-UR-88-3139; CONF-8808145-4) Avail: NTIS HC A03

We discuss classical solutions of U(N) sigma models in two dimensions. We show how from these solutions we can construct solutions of the U(N) sigma model with the Wess-Zumino term (with an arbitrary coefficient). We discuss briefly various properties of these solutions. Next we consider the O(3) sigma model in 2 + 1 dimensions and describe the preliminary results of some numerical work in which we studied the time evolution of some of the previously discussed two dimensional structures (instantons and anti-instantons) under suitable assumptions about their initial values. DOE

N89-15631*# Computer Sciences Corp., Hampton, VA.
FLEXAN (VERSION 2.0) USER'S GUIDE
Scott S. Stallcup Washington, DC Jan. 1989 41 p
(Contract NAS1-17999)
(NASA-CR-4214; NAS 1.26:4214; TAO-50287) Avail: NTIS HC A03/MF A01 CSCL 09B

The FLEXAN (Flexible Animation) computer program, Version 2.0 is described. FLEXAN animates 3-D wireframe structural dynamics on the Evans and Sutherland PS300 graphics workstation with a VAX/VMS host computer. Animation options include: unconstrained vibrational modes, mode time histories (multiple modes), delta time histories (modal and/or nonmodal deformations), color time histories (elements of the structure change colors through time), and rotational time histories (parts of the structure rotate through time). Concurrent color, mode, delta, and rotation, time history animations are supported. FLEXAN does not model structures or calculate the dynamics of structures; it only animates data from other computer programs. FLEXAN was developed to aid in the study of the structural dynamics of spacecraft. Author

N89-15632# Physics and Electronics Lab. TNO, The Hague (Netherlands).
ANAFEED: A CAD SOFTWARE PACKAGE FOR ANALYSIS OF COMPLICATED NETWORKS AT MICROWAVE FREQUENCIES
P. A. M. Verheijen Sep. 1987 99 p In DUTCH; ENGLISH summary Original contains color illustrations
(Contract A78/K/040)
(FEL-1987-53; TD-87-5009; ETN-89-93410) Avail: NTIS HC A05/MF A01

A CAD software package was developed for the analysis of microwave networks with a large number of input and output ports, and primarily for power distribution networks for array antennas. The program can be used for various types of network in all frequency bands. Examples are given of a constrained feed waveguide network at 35 GHz for a low-sidelobe linear array

antenna and for a Butler matrix in the X-band. This software package is especially necessary when low-sidelobe array antennas operating in a wide frequency band are desired. A linear phased array antenna with electronic scan in one plane, including the mentioned 35 GHz linear array antenna, is almost realized. ESA

N89-15633# Ecole Nationale Superieure des Telecommunications, Paris (France). Dept. Signal.
SPECTROGRAM SEGMENTATION. KNOWLEDGE ACQUISITION
Lorenza Saitta (Turin Univ., Italy) 1988 40 p
(ENST-88D010; ETN-89-93621) Avail: NTIS HC A03/MF A01

A methodology for refining and organizing the knowledge obtained from an expert domain is presented, along with a set of experiments in vocal spectrogram analysis. The acquired descriptive knowledge is represented as a set of frames, whereas the control knowledge is represented by production rules. A tentative version of the rules was obtained through transcription of the content of interviews. This version is processed by an automated algorithm, whose goal is to reorganize the rules into more compact and consistent ones. ESA

N89-15634# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Abteilung Textverarbeitungssysteme.
TEX-LOCAL GUIDE FOR VM/CMS
Dieter Kraft and Klaus Kretschel Jul. 1988 37 p In GERMAN; ENGLISH summary
(DFVLR-Mitt-88-21; ISSN-0176-7739; ETN-89-93661) Avail: NTIS HC A03/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 14 Deutsche marks

The use of the software package TEX for computer typesetting under the IBM operating system VM/CMS is explained. ESA

N89-15635# Royal Signals and Radar Establishment, Malvern (England).
A MONTE CARLO PERFORMANCE ANALYSIS OF ACCELERATED SVD-BASED HIGH DISCRIMINATION ALGORITHMS
J. L. Mather Jul. 1988 138 p
(RSRE-MEMO-4083; BR107340; ETN-89-93662) Copyright Avail: NTIS HC A07/MF A01

It is shown how the singular value decomposition based rank reduction of the constrained calibration matrix, M, leads to a scheme for accelerating the data analysis required by high discrimination algorithms such as MUSIC. The scheme is termed an eigenvector projection method (EPM). In the spatial resolution problem, the achievable speed-up depends on the angular limits to the required reconstruction, the degree of spatial oversampling, and the assumed signal to noise ratio. The rank reduction may sometimes be taken to the extreme of choosing only m+1 significant basis vectors, where m is the number of signals to be detected, in order to obtain maximum processing economy without degradation of the source reconstruction. A substantial decrease in processing time is possible. Monte Carlo results demonstrate significant improvements in the ability of high discrimination algorithms to extract signal parameters from noisy data, following processing by EPM. ESA

N89-15636# Royal Signals and Radar Establishment, Malvern (England).
THE INSIDE/OUTSIDE ALGORITHM: GRAMMATICAL INFERENCE APPLIED TO STOCHASTIC CONTEXT-FREE GRAMMARS
Lorraine Dodd Jun. 1988 22 p
(RSRE-MEMO-4160; BR107066; ETN-89-93665; AD-A199685) Copyright Avail: NTIS HC A03/MF A01

The Inside-Outside algorithm which re-estimates the rewrite rule probabilities of a stochastic context-free grammar is described. Application to the spelling of English words is shown. Problems with underflow, i.e., multiplications of very small probabilities which quickly approach the lower limit for real value in computer terms, are discussed. ESA

62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

N89-15637# University of Southern California, Marina del Rey. Information Sciences Inst.
FAST WORKSTATION PROJECT OVERVIEW
Robert Neches Jul. 1988 27 p
(Contract MDA903-86-C-0178)
(AD-A197924; ISI/RR-88-203) Avail: NTIS HC A03/MF A01 CSCL 12G

The FAST Workstation and the FAST Broker projects are companion efforts, which jointly seek to demonstrate a model for the pursuit of electronic commerce. This model is being instantiated in a system supporting procurement of standard electronic parts at low cost with short lead times, which seeks to provide a useful purchasing and information service to DOD and the DARPA very large scale integration (VLSI) research community. The FAST Broker project focuses on utilization of rapid electronic networks to provide an intermediary that speeds communications between buyers and vendors. The FAST Workstation project focuses on the development of user and software interfaces to enable human participants in the process to easily integrate information and engage in transactions with the system. This overview of the FAST Workstation project is divided into four parts. Section 1 describes the research goals of the effort. Section 2 discusses the relationship between those research goals and the somewhat more applied goals of the overall FAST effort. Section 3 reviews our research approach in the four major activity areas of the project. Section 4 summarizes accomplishments to date. GRA

N89-15638# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
CODE-MAPPING POLICIES FOR THE TAGGED-TOKEN DATAFLOW ARCHITECTURE M.S. Thesis
Gino K. Maa May 1988 90 p
(Contract N00014-84-K-0099)
(AD-A198054; MIT/LCS/TR-425) Avail: NTIS HC A05/MF A01 CSCL 12F

Multiprocessing seems to be the only viable way to gain significant speedup beyond that afforded by performance advances in semiconductor devices and hardware construction, which are beginning to face the limitations of physics. Although it is relatively easy to improve the raw computational performance of a system simply by adding more processors to it, the far more difficult task is to insure that the additional resources actually reduce a program's computing time. Thus, the ultimate success of multiprocessing as a means of increasing computation speed rests on the ability to parallelize computation: to partition, allocate, distribute, and schedule work efficiently amongst the large collection of available system resources, while maintaining a high rate of utilization of these resources. To keep many processors busy with work, it is necessary that the program has enough concurrent operations to map to those processors. But given that there is much concurrency in many large programs, the onus lies on the code-mapping process to maintain as much concurrency as is feasible without compromising its efficiency. This goal maximizes the scalability of the system. Our study is based on a dataflow computer, the MIT Tagged-Token Dataflow Architecture (TTDA). This study focuses on analyzing the effectiveness of the code-mapping policies for the TTDA. GRA

N89-15639# Bolt, Beranek, and Newman, Inc., Cambridge, MA.
CRONUS: A DISTRIBUTED OPERATING SYSTEM. VOLUME 2: FUNCTIONAL DEFINITION AND SYSTEM CONCEPT Final Report, Oct. 1984 - Jan. 1986
Richard E. Schantz and Robert H. Thomas Jun. 1988 99 p

(Contract F30602-84-C-0171)
(AD-A199890; BBN-5879-Vol-2; RADC-TR-88-132-Vol-2) Avail: NTIS HC A05/MF A01 CSCL 12E

This is the final report for the second contract phase for development of the Cronus Project. Cronus is the name given to the distributed operating system (DOS) and system architecture for distributed application development environment being designed and implemented by BBN Laboratories for the Air Force Rome Air Development Center (RADC). The project was begun in 1981. The Cronus distributed operating system is intended to promote resource sharing among interconnected computer systems and manage the collection of resources which are shared. Its major purpose is to provide a coherent and integrated system based on clusters of interconnected heterogeneous computers to support the development and use of distributed applications. Distributed applications range from simple programs that merely require convenient reference to remote data, to collections of complex subsystems tailored to take advantage of a distributed architecture. One of the main contributions of Cronus is a unifying architecture and model for developing these distributed applications, as well as support for a number of system provided functions which are common to many applications. GRA

N89-15640# Bolt, Beranek, and Newman, Inc., Cambridge, MA.
CRONUS: A DISTRIBUTED OPERATING SYSTEM. VOLUME 3 Final and Interim Technical Report No. 5, Oct. 1984 - Jan. 1986
Richard E. Schantz, K. Schroder, M. Barrow, G. Bono, and M. Dean Jun. 1988 58 p
(Contract F30602-84-C-0171)
(AD-A199891; BBN-5991-Vol-3; RADC-TR-88-132-Vol-3) Avail: NTIS HC A04/MF A01 CSCL 12E

This is the final report for the second contract phase for development of the Cronus Project. Cronus is the name given to the distributed operating system (DOS) and system architecture for distributed application development environment being designed and implemented by BBN Laboratories for the Air Force Rome Air Development Center. The project was begun in 1981. The Cronus distributed operating system is intended to promote resource sharing among interconnected computer systems and manage the collection of resources which are shared. Its major purpose is to provide a coherent and integrated system based on clusters of interconnected heterogeneous computers to support the development and use of distributed applications. Distributed applications range from simple programs that merely require convenient reference to remote data, to collections of complex subsystems tailored to take advantage of a distributed architecture. One of the main contributions of Cronus is a unifying architecture and model for developing these distributed applications, as well as support for a number of system provided functions which are common to many applications. GRA

N89-15641# Bolt, Beranek, and Newman, Inc., Cambridge, MA.
CRONUS: A DISTRIBUTED OPERATING SYSTEM. VOLUME 4: CRONUS DOS IMPLEMENTATION Final Report, Oct. 1984 - Jan. 1986
Richard E. Schantz, E. Schroder, M. Barrow, G. Bono, and M. Dean Jun. 1988 62 p
(Contract F30602-84-C-0171)
(AD-A199892; BBN-6183-Vol-4; RADC-TR-88-132-Vol-4) Avail: NTIS HC A04/MF A01 CSCL 12E

This is the final report for the second contract phase for development of the Cronus Project. Cronus is the name given to the distributed operating system (DOS) and system architecture for distributed application development environment being designed and implemented by BBN Laboratories for the Air Force Rome Air Development Center (RADC). The project was begun in 1981. The Cronus distributed operating system is intended to promote resource sharing among interconnected computer systems and manage the collection of resources which are shared. Its major purpose is to provide a coherent and integrated system based on clusters of interconnected heterogeneous computers to support the development and use of distributed applications. Distributed applications range from simple programs that merely require convenient reference to remote data, to collections of complex distributions of Cronus is a unifying architecture and model for developing these distributed applications, as well as support for a number of system-provided functions which are common to many applications. GRA

N89-15642# Bolt, Beranek, and Newman, Inc., Cambridge, MA.
CRONUS: A DISTRIBUTED OPERATING SYSTEM. VOLUME 1: REVISED SYSTEM/SUBSYSTEM SPECIFICATION Final Technical Report, Oct. 1984 - Jan. 1986
Richard E. Schantz, K. Schroder, M. Barrow, G. Bono, and M. Dean Jun. 1988 176 p
(Contract F30602-84-C-0171; AF Proj. 2530)
(AD-A199986; BBN-5884; RADC-TR-88-132-Vol-1) Avail: NTIS HC A09/MF A01 CSCL 12E

This is the final report for the second contract phase for development of the Cronus Project. Cronus is the name given to the distributed operating system (DOS) and system architecture for distributed application development environment being designed and implemented by BBN Laboratories for the Air Force Rome Air Development Center (RADC). The project was begun in 1981. The Cronus distributed operating system is intended to promote resource sharing among interconnected computer systems and manage the collection of resources which are shared. Its major purpose is to provide a coherent and integrated system based on clusters of interconnected heterogeneous computers to support the development and use of distributed applications. Distributed applications range from simple programs that merely require convenient reference to remote data, to collections of complex subsystems tailored to take advantage of a distributed architecture. One of the main contributions of Cronus is a unifying architecture and model for developing these distributed applications, as well as support for a number of system-provided functions which are common to many applications. GRA

N89-15643# Amherst Systems, Inc., Buffalo, NY.
A SURVEY OF PARALLEL COMPUTING Final Technical Report, Jun. 1987 - Feb. 1988
Susan E. Miller Jul. 1988 200 p
(Contract F30602-87-C-0082)
(AD-A199987; RADC-TR-88-129) Avail: NTIS HC A09/MF A01 CSCL 12E

This report summarizes the research accomplished under a Small Business Innovation Research (SBIR) Phase 1 contract F30602-87-C-0082. Until recently, software engineering technology has focused on the use of conventional von Neumann computer architectures. Current computer systems feature continually increasing computational resource requirements which have become unfeasible or unrealizable using conventional von Neumann techniques. Non-von Neumann architectures featuring multiple processing elements offer solutions that achieve the application requirement. However, software engineering technology remains oriented towards von Neumann methodologies. This, coupled with the applications specific nature of non-von Neumann architectures, has resulted in a fragmented software engineering environment. This effort provided a very thorough view of many of the software engineering problems that are currently associated with the utilization of non-von Neumann computers. The results of this study support current and future applications programs by providing sound rules to architecture selection and systems and software life cycle definition. GRA

N89-15644# Argonne National Lab., IL.
LARGE-GRAIN PIPELINING ON HYPERCUBE MULTIPROCESSORS
Chung-Ta King (Michigan State Univ., East Lansing.) and Lionel M. Ni 1988 9 p Presented at the 3rd Conference on Hypercube Concurrent Computers and Applications, Pasadena, CA, 19 Jan. 1988
(Contract W-31-109-eng-38)
(DE89-000523; CONF-880117-6) Avail: NTIS HC A02/MF A01

A new paradigm, called large-grain pipelining, for developing

efficient parallel algorithms on distributed-memory multiprocessors, e.g., hypercube machines, is introduced. Large-grain pipelining attempts to maximize the degree of overlapping and minimize the effect of communication overhead in a multiprocessor system through macro-pipelining between the nodes. Algorithms developed through large-grain pipelining to perform matrix multiplication are presented. To model the pipelined computations, an analytic model is introduced, which takes into account both underlying architecture and algorithm behavior. Through the analytical model, important design parameters, such as data partition sizes, can be determined. Experiments were conducted on a 64-node NCUBE multiprocessor. The measured results match closely with the analyzed results, which establishes the analytic model as an integral part of algorithm design. Comparison with an algorithm which does not use large-grain pipelining also shows that large-grain pipelining is an efficient scheme for achieving a greater parallelism. DOE

N89-15645# Argonne National Lab., IL. Div. of Mathematics and Computer Science.
PIPELINED DATA PARALLEL ALGORITHMS: CONCEPT AND MODELING
Chung-Ta King, Wen-Hwa Chou (Michigan State Univ., East Lansing.), and Lionel M. Ni 1988 11 p Presented at the International Conference on Supercomputing, Saint-Malo, France, 4 Jul. 1988 Sponsored by DARPA ACMP Project, Washington, DC
(Contract W-31-109-eng-38)
(DE89-000536; CONF-8807116-1) Avail: NTIS HC A03/MF A01

A new style of efficient parallel algorithms on distributed-memory multiprocessors is introduced, which exploits parallelism through pipelined parallel computation, or large-grain pipelining. By using macro-pipelining between nodes in the system, large-grain pipelining regulates the flows of data in the multiprocessor so that the degree of overlapping can be maximized and the effect of communication overhead can be minimized. To model pipelined parallel computations, an analytic model is presented, which takes into account both underlying architecture and algorithm behavior. The resultant model is accurate enough to not only predict the performance of a given algorithm, but also assist in algorithm designs for determining optimal design parameters such as the granularity. Results from experiments performed on a 64-node NCUBE multiprocessor match closely to the predicted performance. A systematic procedure for designing pipelined data parallel algorithms from nested loop programs is described. The impact of the second generation distributed-memory multiprocessors on the pipelined parallel computations is also discussed. DOE

N89-15646# Royal Signals and Radar Establishment, Malvern (England). Speech Research Unit.
A COMPARISON OF NONLINEAR OPTIMISATION STRATEGIES FOR FEED-FORWARD ADAPTIVE LAYERED NETWORKS
A. R. Webb, D. Lowe, and M. D. Bedworth 5 Jul. 1988 37 p
(RSRE-MEMO-4157; BR107338; ETN-89-93664) Copyright
Avail: NTIS HC A03/MF A01

Learning strategies which may be employed for the generic class of layered feed-forward adaptive networks exemplified by the traditional multilayer perceptron are discussed. Such a network is only useful if a set of weight values exists which allows the network to form a good approximation to an underlying (and possibly unknown) transformation between input and output patterns. The need for schemes capable of producing such a set of weights, (should one exist) as efficiently as possible is highlighted. The application of various learning algorithms to examples ranging from small scale trivial problems (solution of the XOR function), to larger scale pattern processing applications (speech recognition of isolated confusable whole words) is considered. ESA

N89-15647# Royal Signals and Radar Establishment, Malvern (England). Speech Research Unit.
A THEOREM CONNECTING ADAPTIVE FEED-FORWARD LAYERED NETWORKS AND NONLINEAR DISCRIMINANT ANALYSIS
A. R. Webb and D. Lowe 12 Aug. 1988 31 p
(RSRE-MEMO-4209; BR107727; ETN-89-93668) Copyright
Avail: NTIS HC A03/MF A01

A theorem which illustrates why a general adaptive feedforward layered network with linear output units can perform well as a pattern classification device is presented. The central result is that minimizing the error at the output of the network is equivalent to maximizing a particular norm, the network cost function, at the output of the hidden units. If the total covariance matrix is full rank and the targets are appropriately chosen, this cost function relates the inverse of the total covariance matrix and the weighted between class covariance matrix of the hidden unit patterns. In a linear network it is shown how the theorem can reproduce the result obtained by Gallinari et al., (1988) as a special case. Numerical simulations illustrate the theorem and show that alternative choices for the cost function at the hidden layer are not maximized, generally, in a nonlinear situation. ESA

N89-15648*# California Univ., Berkeley.
MACHINE CHARACTERIZATION AND BENCHMARK PERFORMANCE PREDICTION
Rafael H. Saavedra-Barrera Dec. 1988 80 p
(Contract NCA2-128)
(NASA-CR-177511; NAS 1.26:177511) Avail: NTIS HC A05/MF A01 CSCL 12A

From runs of standard benchmarks or benchmark suites, it is not possible to characterize the machine nor to predict the run time of other benchmarks which have not been run. A new approach to benchmarking and machine characterization is reported. The creation and use of a machine analyzer is described, which measures the performance of a given machine on FORTRAN source language constructs. The machine analyzer yields a set of parameters which characterize the machine and spotlight its strong and weak points. Also described is a program analyzer, which analyzes FORTRAN programs and determines the frequency of execution of each of the same set of source language operations. It is then shown that by combining a machine characterization and a program characterization, we are able to predict with good accuracy the run time of a given benchmark on a given machine. Characterizations are provided for the Cray-X-MP/48, Cyber 205, IBM 3090/200, Amdahl 5840, Convex C-1, VAX 8600, VAX 11/785, VAX 11/780, SUN 3/50, and IBM RT-PC/125, and for the following benchmark programs or suites: Los Alamos (BMK8A1), Baskett, Linpack, Livermore Loops, Madelbrot Set, NAS Kernels, Shell Sort, Smith, Whetstone and Sieve of Erathostenes. Author

63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

N89-15649*# Alabama Univ., Huntsville. Research Center.
APPLICATIONS OF ARTIFICIAL INTELLIGENCE TO SPACE STATION: GENERAL PURPOSE INTELLIGENT SENSOR INTERFACE Final Report, 1987-1988
James W. McKee Sep. 1988 86 p
(Grant NAG8-641)
(NASA-CR-184572; NAS 1.26:184572; UAH-RR-728) Avail: NTIS HC A05/MF A01 CSCL 09B

This final report describes the accomplishments of the General Purpose Intelligent Sensor Interface task of the Applications of Artificial Intelligence to Space Station grant for the period from October 1, 1987 through September 30, 1988. Portions of the First Biannual Report not revised will not be included but only referenced. The goal is to develop an intelligent sensor system

that will simplify the design and development of expert systems using sensors of the physical phenomena as a source of data. This research will concentrate on the integration of image processing sensors and voice processing sensors with a computer designed for expert system development. The result of this research will be the design and documentation of a system in which the user will not need to be an expert in such areas as image processing algorithms, local area networks, image processor hardware selection or interfacing, television camera selection, voice recognition hardware selection, or analog signal processing. The user will be able to access data from video or voice sensors through standard LISP statements without any need to know about the sensor hardware or software. Author

N89-15650# Northeast Artificial Intelligence Consortium, Syracuse, NY.
NORTHEAST ARTIFICIAL INTELLIGENCE CONSORTIUM ANNUAL REPORT 1986: THE VERSATILE MAINTENANCE EXPERT SYSTEM (VMES) PROJECT, VOLUME 2 Interim Report, Jan. - Dec. 1986
S. C. Shapiro, S. N. Srihari, M. R. Taie, J. Geller, and S. S. Campbell Jun. 1988 135 p
(Contract F30602-85-C-0008)
(AD-A197859; RADC-TR-88-11-Vol-2) Avail: NTIS HC A07/MF A01 CSCL 12I

The Northeast Artificial Intelligence Consortium (NAIC) was created by the Air Force Systems Command, Rome Air Development Center, and the Office of Scientific Research. Its purpose is to conduct pertinent research in artificial intelligence and to perform activities ancillary to this research. This report describes progress that has been made in the second year of the existence of the NAIC on the technical research tasks undertaken at the member universities. The topics covered in general are: versatile expert system for equipment maintenance, distributed AI for communications system control, automatic photo interpretation, time-oriented problem solving, speech understanding systems, knowledge base maintenance, hardware architectures for very large systems, knowledge-based reasoning and planning, and a knowledge acquisition, assistance, and explanation system. The specific topic for this volume is the exploration of methods for developing a Versatile Maintenance Expert System (VMES). GRA

N89-15651# Northeast Artificial Intelligence Consortium, Syracuse, NY.
NORTHEAST ARTIFICIAL INTELLIGENCE CONSORTIUM ANNUAL REPORT 1986. VOLUME 4, PART A. HIERARCHICAL REGION-BASED APPROACH TO AUTOMATIC PHOTOINTERPRETATION. PART B. APPLICATION OF AI TECHNIQUES TO IMAGE SEGMENTATION AND REGION IDENTIFICATION Interim Report, Jan. - Dec. 1986
James W. Modestino and George Nagy Jan. 1988 63 p
(Contract F30602-85-C-0008)
(AD-A197958; RADC-TR-88-11-Vol-4-Pt-A/B) Avail: NTIS HC A04/MF A01 CSCL 12I

The Northeast Artificial Intelligence Consortium's purpose is to conduct pertinent research in artificial intelligence and to perform activities ancillary to this research. This report describes progress that has been made in the second year of the existence of the NAIC on the technical research tasks undertaken at the member universities. The topics covered in general are: versatile expert system for equipment maintenance, distributed AI for communications system control, automatic photointerpretation, time-oriented problem solving, speech understanding systems, knowledge base maintenance, hardware architectures for very large systems, knowledge-based reasoning and planning, and a knowledge acquisition, assistance, and explanation system. The specific topics for this volume are the use of expert systems for automated photointerpretation and other AI techniques to image segmentation and region identification. GRA

N89-15652# Northeast Artificial Intelligence Consortium, Syracuse, NY.
NORTHEAST ARTIFICIAL INTELLIGENCE CONSORTIUM ANNUAL REPORT 1986: ARTIFICIAL INTELLIGENCE APPLICATIONS TO SPEECH RECOGNITION, VOLUME 7 Interim Report, Jan. - Dec. 1986
H. E. Rhody, J. Hillenbrand, and J. A. Biles Jun. 1988 68 p
(Contract F30602-85-C-0008)
(AD-A198058; RADC-TR-88-11-Vol-7) Avail: NTIS HC A04/MF A01 CSCL 12I

The Northeast Artificial Intelligence Consortium's purpose is to conduct pertinent research in artificial intelligence and to perform activities ancillary to this research. The topics covered in general are: versatile expert system for equipment maintenance, distributed AI for communications system control, automatic photo interpretation, time-oriented problem solving, speech understanding systems, knowledge base maintenance, hardware architectures for very large systems, knowledge-based reasoning and planning, and a knowledge acquisition, assistance, and explanation system. The specific topic for this volume is the design and implementation of a knowledge-based system to read speech spectrograms. GRA

N89-15653# Syracuse Univ., NY.
NORTHEAST ARTIFICIAL INTELLIGENCE CONSORTIUM ANNUAL REPORT FOR 1986. VOLUME 1: EXECUTIVE SUMMARY Interim Report, Jan. - Dec. 1986
Volker Weiss and James F. Brule Jun. 1988 38 p Prepared in cooperation with the Northeast Artificial Intelligence Consortium, Syracuse, NY
(Contract F30602-85-C-0008)
(AD-A198085; RADC-TR-88-11-Vol-1) Avail: NTIS HC A03/MF A01 CSCL 12I

The Northeast Artificial Intelligence Consortium's (NAIC) purpose is to conduct pertinent research in artificial intelligence and to perform activities ancillary to this research. This report describes progress that has been made in the second year of existence. The topics covered in general are: versatile expert system for equipment maintenance, distributed AI for communications system control, automatic photo interpretation, time-oriented problem solving, speech understanding systems, knowledge base maintenance, hardware architectures for very large systems, knowledge-based reasoning and planning, and a knowledge acquisition, assistance and explanation systems. GRA

N89-15654# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Computer Science.
INFORMATION PROCESSING RESEARCH Final Report, Jan. 1985 - Sep. 1987
J. G. Carbonell, S. E. Fahlman, A. L. Fisher, D. A. Giuse, and A. N. Haberman May 1988 207 p
(Contract F33615-84-K-1520)
(AD-A198201; CMU-CS-88-110; AFWAL-TR-88-1024) Avail: NTIS HC A10/MF A01 CSCL 09A

The research areas and their main objectives are: (1) Distributed processing: Develop techniques and systems for effective use of numerous separate computers interconnected by high-bandwidth, local area networks. This effort involves developing a methodology for efficient utilization of distributed (loosely connected) personal computers; (2) Image Understanding: Apply knowledge effectively in assisting the image interpretation process; (3) Machine Intelligence: Explore ways to utilize knowledge in obtaining intelligent action by computers. Long range goals of this effort include the discovery of principles that enable intelligent action and the construction of computer systems that can perform tasks requiring intelligence; (4) Programming Technology: Develop new techniques and methods for generating better software; (5) Distributed Sensor Nets: Construct a demonstration system of physically and logically distributed computers interacting through a communication network to identify, track, and display the situation of multiple objects in a laboratory environment; (6) Graceful Interaction: Design, construct, and evaluate user interface systems

that both appear cooperative and supportive to their users and can provide interfaces to a wide variety of application systems; and (7) VLSI Systems Integration (VLSI). GRA

N89-15655# Syracuse Univ., NY.
NORTHEAST ARTIFICIAL INTELLIGENCE CONSORTIUM ANNUAL REPORT 1986. VOLUME 6, PART A: COMPUTER ARCHITECTURES FOR VERY LARGE KNOWLEDGE BASES Interim Technical Report, Jan. - Dec. 1986
P. B. Berra Jun. 1988 223 p
(Contract F30602-85-C-0008)
(AD-A198285; RADC-TR-88-11-Vol-6-Pt-A) Avail: NTIS HC A10/MF A01 CSCL 12I

The Northeast Artificial Intelligence Consortium (NAIC) was created to conduct pertinent research in artificial intelligence and to perform activities ancillary to this research. This report describes: versatile expert system for equipment maintenance, distributed AI for communications system control, automatic photo interpretation, time-oriented problem solving, speech understanding systems, knowledge base maintenance, hardware architectures for very large systems, knowledge-based reasoning and planning, and a knowledge acquisition, assistance, and explanation system. The specific topic for this volume (Part A) is the development of architectures for very large knowledge bases, especially in light of real-time requests, parallelism, and the advent of optical computing. GRA

N89-15656# Syracuse Univ., NY.
NORTHEAST ARTIFICIAL INTELLIGENCE CONSORTIUM ANNUAL REPORT 1986. VOLUME 6, PART B: KNOWLEDGE BASE MAINTENANCE USING LOGIC PROGRAMMING METHODOLOGIES Interim Technical Report, Jan. - Dec. 1986
Kenneth W. Bowen Jun. 1988 69 p Prepared in cooperation with Northeast Artificial Intelligence Consortium, Syracuse, NY
(Contract F30602-85-C-0008)
(AD-A198286; RADC-TR-88-11-Vol-6-Pt-B) Avail: NTIS HC A04/MF A01 CSCL 12I

The Northeast Artificial Intelligence Consortium (NAIC) was created to conduct pertinent research in artificial intelligence and to perform activities ancillary to this research. The topics covered in general are: versatile expert system for equipment maintenance, distributed AI for communications system control, automatic photo interpretation, time-oriented problem solving, speech understanding systems, knowledge base maintenance, hardware architectures for very large systems, knowledge-based reasoning and planning, and a knowledge acquisition, assistance, and explanation system. The specific topic for this volume is the use of logic programming methodologies for knowledge base maintenance. GRA

N89-15657# Syracuse Univ., NY. Dept. of Computer Science.
NORTHEAST ARTIFICIAL INTELLIGENCE CONSORTIUM ANNUAL REPORT 1986. VOLUME 8, PART A: TIME ORIENTED PROBLEM SOLVING Interim Technical Report, Jan. - Dec. 1986
James F. Allen Jun. 1988 131 p Prepared in cooperation with Northeast Artificial Intelligence Consortium, Syracuse, NY
(Contract F30602-85-C-0008)
(AD-A198287; RADC-TR-88-11-Vol-8-Pt-A) Avail: NTIS HC A07/MF A01 CSCL 12I

The Northeast Artificial Intelligence Consortium's (NAIC) purpose is to conduct pertinent research in artificial intelligence and to perform activities ancillary to this research. This report covered such topics as: versatile expert system for equipment maintenance, distributed AI for communications system control, automatic photo interpretation, time oriented problem solving, speech understanding systems, knowledge base maintenance, hardware architectures for very large systems, knowledge-based reasoning and planning, and a knowledge acquisition, assistance, and explanation system. The specific topic for this volume is a model theory and axiomatization of a logic for reasoning about planning in domains of concurrent actions. GRA

N89-15658# Syracuse Univ., NY.
NORTHEAST ARTIFICIAL INTELLIGENCE CONSORTIUM. VOLUME 8, PART B: PARALLEL, STRUCTURAL, AND OPTIMAL TECHNIQUES IN VISION Annual Report, Jan. - Dec. 1986
Christopher M. Brown Jun. 1988 236 p Prepared in cooperation with Rochester Univ., NY
(Contract F30602-85-C-0008)
(AD-A198597; RADC-TR-88-11-Vol-8-Pt-B) Avail: NTIS HC A11/MF A01 CSCL 12I

The Northeast Artificial Intelligence Consortium's purpose is to conduct pertinent research in artificial intelligence and to perform activities ancillary to this research. These volumes describe progress that has been made in the second year of the existence of the NAIC on the technical research tasks undertaken at the member universities. The topics covered in general are: versatile expert system for equipment maintenance, distributed AI for communications system control, automatic photo interpretation, time-oriented problem solving, speech understanding systems, knowledge base maintenance, hardware architectures for very large systems, knowledge-based reasoning and planning, and a knowledge acquisition, assistance, and explanation system. This part addresses various aspects of parallel, structural, and optimal techniques in computer vision. GRA

N89-15659# Ecole Nationale Superieure des Telecommunications, Paris (France). Dept. Signal.
OBJECT MODELING FOR THE REPRESENTATION OF COMPLEX KNOWLEDGE Ph.D. Thesis [MODELISATION OBJET POUR LA REPRESENTATION DE CONNAISSANCES COMPLEXES]
Therese Martelli Mar. 1988 273 p In FRENCH
(ENST-88E005; ISSN-0751-1353; ETN-89-93624) Avail: NTIS HC A12/MF A01

An object oriented formalism that is able to represent all the knowledge used in speech signal processing is defined. An object oriented language to handle complex knowledge was developed. The model developed is able to make algorithms collaborate for problem solving in the area of speech processing and more generally in signal processing. ESA

N89-15660# Ecole Nationale Superieure des Telecommunications, Paris (France).
SPEAKER INDEPENDENT CONNECTED WORD RECOGNITION USING HIDDEN MARKOV MODELS Ph.D. Thesis [RECONNAISSANCE DE MOTS CONNECTES INDEPENDAMMENT DU LOCUTEUR PAR DES METHODES STATISTIQUES]
Denis Jouvet Jun. 1988 283 p Partly in ENGLISH and FRENCH
(ENST-88E006; ISSN-0751-1353; ETN-89-93625) Avail: NTIS HC A13/MF A01

A speaker independent connected word speech recognition system with an integrated network and using gaussian probability density functions was developed. The compilation of the network from all the a priori knowledge of the application (syntax, phonetical descriptions, phonological rules) is explained. Tests to compare the efficiency of different basic units like words, syllables, phonemes, diphones, and allophones were realized. An error rate of 7.8 percent on the French numbers between 0 and 999 is obtained by using directly word units. Using smaller units such as phonemes and introducing allophones improves the contextual influence modeling and significantly reduces the size of the model, achieving a 4.3 percent error rate. ESA

N89-15551*# Rockwell International Corp., Palo Alto, CA. Science Center.
REAL-TIME CONTROL FOR MANUFACTURING SPACE SHUTTLE MAIN ENGINES: WORK IN PROGRESS
Corinne C. Ruokangas *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 5-18 (For primary document see N89-15549

07-61)
(Contract NAS8-40000)
Avail: NTIS HC A21/MF A01 CSCL 09B

N89-15557*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
ISSUES IN MANAGEMENT OF ARTIFICIAL INTELLIGENCE BASED PROJECTS
P. A. Kiss (BDM Corp., Huntsville, AL.) and Michael S. Freeman *In its* Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 59-66 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

N89-15559*# Alabama A & M Univ., Huntsville. Dept. of Computer and Information Science.
PLANNING ACTIONS IN ROBOT AUTOMATED OPERATIONS
A. Das *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 69-74 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

N89-15560*# Worcester Polytechnic Inst., MA.
INTEGRATION OF TASK LEVEL PLANNING AND DIAGNOSIS FOR AN INTELLIGENT ROBOT
Arthur Gerstenfeld *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 75-84 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

N89-15561*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
A GRAPHICAL, RULE BASED ROBOTIC INTERFACE SYSTEM
James W. McKee (Alabama Univ., Huntsville.) and John Wolfsberger *In its* Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 85-91 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

N89-15569*# Alabama Univ., Huntsville. Dept. of Computer Science.
ARTIFICIAL INTELLIGENCE APPROACHES TO SOFTWARE ENGINEERING
James D. Johannes and James R. MacDonald *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 141-150 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

N89-15588*# Boeing Co., Seattle, WA. Electronics.
AN ARCHITECTURE FOR AN AUTONOMOUS LEARNING ROBOT
Brian Tillotson *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 281-288 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

N89-15589*# Alberta Univ., Edmonton. Dept. of Computing Science.
TOWARD A COMPUTATIONAL THEORY FOR MOTION UNDERSTANDING: THE EXPERT ANIMATORS MODEL
Ahmed S. Mohamed and William W. Armstrong *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applicatins Oct. 1988 p 289-302 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

N89-15599*# Rockwell International Corp., Downey, CA. SBI Software Engineering.
ARTIFICIAL INTELLIGENCE APPLICATIONS IN SPACE AND SDI: A SURVEY
Harvey E. Fiala *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 381-390 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 09B

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N89-15661*# Tennessee State Univ., Nashville. Dept. of Electrical Engineering.
ROBUST CONTROL WITH STRUCTURED PERTURBATIONS Semiannual Report
Leehyun Keel 14 Dec. 1988 67 p
(Grant NAG1-863)
(NASA-CR-184586; NAS 1.26:184586) Avail: NTIS HC A04/MF A01 CSCL 12A

Two important problems in the area of control systems design and analysis are discussed. The first is the robust stability using characteristic polynomial, which is treated first in characteristic polynomial coefficient space with respect to perturbations in the coefficients of the characteristic polynomial, and then for a control system containing perturbed parameters in the transfer function description of the plant. In coefficient space, a simple expression is first given for the l(sup 2) stability margin for both monic and non-monic cases. Following this, a method is extended to reveal much larger stability region. This result has been extended to the parameter space so that one can determine the stability margin, in terms of ranges of parameter variations, of the closed loop system when the nominal stabilizing controller is given. The stability margin can be enlarged by a choice of better stabilizing controller. The second problem describes the lower order stabilization problem, the motivation of the problem is as follows. Even though the wide range of stabilizing controller design methodologies is available in both the state space and transfer function domains, all of these methods produce unnecessarily high order controllers. In practice, the stabilization is only one of many requirements to be satisfied. Therefore, if the order of a stabilizing controller is excessively high, one can normally expect to have a even higher order controller on the completion of design such as inclusion of dynamic response requirements, etc. Therefore, it is reasonable to have a lowest possible order stabilizing controller first and then adjust the controller to meet additional requirements. The algorithm for designing a lower order stabilizing controller is given. The algorithm does not necessarily produce the minimum order controller; however, the algorithm is theoretically logical and some simulation results show that the algorithm works in general.

Author

N89-15662# Arizona Univ., Tucson.
NONLINEAR WAVES: COHERENCE, CHAOS, PATTERN FORMATION, AND GEOMETRY Final Report, 1 May 1985 - 31 Dec. 1987
Hermann Flaschka Jun. 1988 18 p
(Contract DAAG29-85-K-0091)
(AD-A198235; ARO-21457.1-MA) Avail: NTIS HC A03/MF A01 CSCL 09C

Coherence and chaos in partial differential equations was studied, with particular emphasis on the damped-driven sine Gordon equation and an optically bistable laser cavity. The propagation of rapidly oscillating nonlinear integrable waves was investigated. The results about propagation in an optically bistable ring cavity the identification of the interplay between coherent transverse spatial structures and temporal chaos in the characteristics of the laser beam. Principal mathematical results on the damped-driven sine-Gordon equation include a numerical study of low dimensional chaotic attractors with coherent spatial structures, including dynamical system diagnostics of their time series, and direct numerical measurements establishing that the attractor is well co-ordinatized by a few nonlinear normal modes; complete analytical identification of all homoclinic structures for the integrable

sine-Gordon equation; direct numerical detection of homoclinic crossings along the chaotic attractor of the full system. Principal mathematical results about the propagation of rapidly oscillating integrable waves include the identification and derivation of a Hamiltonian structure for the modulation equations and a study of the process by which singularities are smoothed by dispersion through the injection of additional degrees of freedom into the field. GRA

N89-15663# Pittsburgh Univ., PA. Center for Multivariate Analysis.
DISCRIMINATION ANALYSIS WHEN THE VARIATES ARE GROUPED AND OBSERVED IN SEQUENTIAL ORDER
Yuehua Wu Feb. 1988 19 p
(Grant AF-AFOSR-0030-88; AF Proj. 2304)
(AD-A198405; TR-88-03; AFOSR-88-0797TR) Avail: NTIS HC A03/MF A01 CSCL 12C

Suppose that measurements x sub i = (x sub i sub 1, ...,X sub i sub j sub i), i = 1,...,k, can be taken on a unit sequentially in that order at the prescribed costs Ci, i = 1,...,k. The unit comes from one of the populations H sub 1 and H sub 2, and it is desired to select a population (from these two) from which the unit is supposed to belong to, on the basis of the measurements x sub 1, x sub 2, ... Given the loss incurred by selecting population H sub i when in fact it belongs to H sub j, the prior probability p sub i of H sub i (i = 1,2), and assuming that H sub i has the normal distribution N (mu sub i, V), i = 1,2, the author derives the sequential Bayesian solution of the discrimination problem when mu sub 1, mu sub 2 and V are known. When mu sub i, V are unknown and must be estimated, he proposes a solution which is asymptotic Bayesian with exponential convergence rate. GRA

N89-15664# Texas Univ., Austin. Center for Numerical Analysis.
OPTIMUM ACCELERATION FACTORS FOR ITERATIVE SOLUTIONS OF LINEAR AND NON-LINEAR AL SYSTEMS Final Report, 1 Dec. 1984 - 31 Mar. 1988
David M. Young, Jr. 15 Mar. 1988 21 p
(Grant AF-AFOSR-0052-85; AF Proj. 2304)
(AD-A198408; AFOSR-88-0790TR) Avail: NTIS HC A03/MF A01 CSCL 12A

The objective of the research is the development and evaluation of iterative methods for solving large systems of linear and nonlinear algebraic equations, with emphasis on systems arising from the discretization by finite difference methods or by finite element methods of problems arising in computational fluid dynamics involving partial differential equations. Special attention is given to the determination of parameters to accelerate the convergence of iterative procedures, for solving the algebraic systems. Two types of approaches have been taken. One approach involves direct consideration of the algebraic system and includes optimization techniques, dual adaptive techniques, and hybrid techniques. As a tool for testing these and other techniques several software packages have been developed as part of the ITPACK project. The other approach involved selection of iteration parameters based on considering methods for solving related time-dependent problems using variable time steps. GRA

N89-15665# Clarkson Univ., Potsdam, NY.
COLLECTIVE PROPERTIES OF NEURAL SYSTEMS AND THEIR RELATION TO OTHER PHYSICAL MODELS Final Report, 1 Jul. 1987 - 31 Aug. 1988
Eytan Barouch and A. S. Fokas 5 Aug. 1988 171 p
(Grant AF-AFOSR-0310-87; AF Proj. 2304)
(AD-A199988; Rept-3; AFOSR-88-1014TR) Avail: NTIS HC A08/MF A01 CSCL 12D

During the tenure of this contract progress was made on three fronts: (1) The recursion operator of the Landau-Lifshitz equation has been completed explicitly. This has been achieved algorithmically by utilizing methods introduced earlier. It should be emphasized that in addition to the important implications of these results to general lattice theories and neural networks, the answers obtained are novel on their own merit since textbooks referred to constructing the above recursion operation as an outstanding open problem. (2) We have continued our study of nonlinear optics. We have introduced a new system of nonlinear PDE's that governs the development path of photoresist fabrication. We have employed a proof given in collaboration with Araki concerning an iteration scheme, used throughout the analysis. We have reported this work in various publications and in a number of international conferences. (3) Substantial progress has been made towards solving the nonlinear Schrodinger (NLS) equation on the half-time. Finite boundedness in conjunction with nonlinear evolution equations have eluded investigators for years. Since nonlinear optics is to be employed on finite boundaries, a major effort was needed to achieve viable results. A new method has been introduced and tested on the NLS on the half-line. GRA

N89-15666# Purdue Univ., West Lafayette, IN. Dept. of Statistics.
ON A SEQUENTIAL SUBSET SELECTION PROCEDURE FOR EXPONENTIAL FAMILY DISTRIBUTIONS
TaChen Liang May 1988 21 p
(Contract N00014-88-K-0170; NSF DMS-86-06964)
(AD-A200013; TR-88-20C) Avail: NTIS HC A03/MF A01 CSCL 12C

The paper deals with the problem of selecting the best population among k populations belonging to the same class of exponential family distributions through sequential subset selection approach. We desire that the best population should be selected and each selected population should be good. Based on the modified likelihood ratio of the conditional frequency function of some statistics, an elimination-type sequential subset selection procedure is proposed. This sequential procedure achieves the selection goal with guaranteed probability at least P* for some prespecified value P*. At each stage, this procedure also provides some statistical inference about an upper bound on the measure of separation from the unknown best population of each remaining contending population. Finally, a modified sequential procedure to select a good population is also studied. This modified sequential procedure achieves the goal of selecting a good population with guaranteed at least P*. GRA

N89-15667# Naval Surface Weapons Center, Silver Spring, MD.
A METHOD FOR THE CALCULATION OF ABSCISSAS AND WEIGHT FACTORS USING GAUSSIAN INTEGRATION FOR INTEGRANDS WITH A LOGARITHMIC SINGULARITY Final Report, Jun. - Sep. 1987
Stephen A. Wilkerson 20 Nov. 1987 30 p
(AD-A199341; NSWC-TR-87-372) Avail: NTIS HC A03/MF A01 CSCL 12B

A method for the calculation of abscissas and weight factors using Gaussian integration for integrands with a logarithmic singularity is presented. The method shows good convergent properties and allows for the accurate estimation of the error. A program is supplied for the generation of orthogonal polynomials with weight Log(x) to order n, and numerical tables for the Gaussian integration method are provided. GRA

N89-15668# Naval Postgraduate School, Monterey, CA.
A NEW CONSERVATIVE SCHEME FOR SOLVING THE TWO BODY PROBLEM Technical Report, Oct. 1986 - Jun. 1987
B. Neta and Y. Ilan-Lipowski Aug. 1988 19 p
(AD-A199345; NPS53-88-009) Avail: NTIS HC A03/MF A01 CSCL 12A

The well known Stormer-Cowell class of linear k-step methods for the solution of second order initial value problems suffer from orbital instability. The solution of a problem describing a uniform motion in a circular orbit, spirals inward. Several modifications were suggested, some require the a-priori knowledge of the frequency. A method is developed here based on the conservation of energy and momentum. This method overcomes the aforementioned difficulty. GRA

N89-15669# Argonne National Lab., IL. Mathematics and Computer Science Div.
COMPUTATION OF CUSP SINGULARITIES FOR OPERATOR EQUATIONS AND THEIR DISCRETIZATIONS
Andreas Griewank and George W. Reddien Aug. 1988 19 p
(Contract W-31-109-eng-38)
(DE89-000695; ANL/MCS-TM-115) Avail: NTIS HC A03/MF A01

We discuss the direct calculation of cusp singularities as solutions of a minimally augmented defining system, which is nonsingular under the canonical cusp conditions. The underlying operator equation may have any finite Fredholm index, and bounds on the discretization error are derived for the case of projection methods. DOE

N89-15670# Argonne National Lab., IL. Mathematics and Computer Science Div.
SEARCHING FOR FIXED POINT COMBINATORS BY USING AUTOMATED THEOREM PROVING: A PRELIMINARY REPORT
Larry Wos and William McCune Sep. 1988 241 p
(Contract W-31-109-eng-38)
(DE89-001324; ANL-88-10) Avail: NTIS HC A11/MF A01

In this report, we establish that the use of an automated theorem- proving program to study deep questions from mathematics and logic is indeed an excellent move. Among such problems, we focus mainly on that concerning the construction of fixed point combinators—a problem considered by logicians to be significant and difficult to solve, and often computationally intensive and arduous. To be a fixed point combinator, THETA must satisfy the equation THETAx = x(THETAx) for all combinators x. The specific questions on which we focus most heavily ask, for each chosen set of combinators, whether a fixed point combinator can be constructed from the members of that set. For answering questions of this type, we present a new, sound, and efficient method, called the kernel method, which can be applied quite easily by hand and very easily by an automated theorem-proving program. For the application of the kernel method by a theorem-proving program, we illustrate the vital role that is played by both paramodulation and demodulation—two of the powerful features frequently offered by an automated theorem-proving program for treating equality as if it is understood. We also state a conjecture that, if proved, establishes the completeness of the kernel method. From what we can ascertain, this method—which relies on the introduced concepts of kernel and superkernel—offers the first systematic approach for searching for fixed point combinators. We successfully apply the new kernel method to various sets of combinators and, for the set consisting of the combinators B and W, construct an infinite set of fixed point combinators such that no two of the combinators are equal even in the presence of extensionality—a law that asserts that two combinators are equal if they behave the same. DOE

N89-15671*# Hampton Inst., VA. Dept. of Computer Science.
INVESTIGATIONS INTO THE SHAPE-PRESERVING INTERPOLANTS USING SYMBOLIC COMPUTATION Final Report, May 1987 - Oct. 1988
Maria Lam 1988 19 p
(Grant NAG1-760)
(NASA-CR-182745; NAS 1.26:182745) Avail: NTIS HC A03/MF A01 CSCL 12A

Shape representation is a central issue in computer graphics and computer-aided geometric design. Many physical phenomena involve curves and surfaces that are monotone (in some directions) or are convex. The corresponding representation problem is given some monotone or convex data, and a monotone or convex interpolant is found. Standard interpolants need not be monotone or convex even though they may match monotone or convex data. Most of the methods of investigation of this problem involve the utilization of quadratic splines or Hermite polynomials. In this investigation, a similar approach is adopted. These methods require derivative information at the given data points. The key to the problem is the selection of the derivative values to be assigned to the given data points. Schemes for choosing derivatives were examined. Along the way, fitting given data points by a conic section has also been investigated as part of the effort to study shape-preserving quadratic splines. Author

N89-15672# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Abteilung Antriebsintegration.
SOLUTION OF THE TWO-DIMENSIONAL EULER EQUATIONS BY A FINITE VOLUME DISCRETIZATION ON UNSTRUCTURED TRIANGULAR MESHES
Arno Ronzheimer Jul. 1988 82 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1135)
(DFVLR-FB-88-34; ISSN-0171-1342; ETN-89-93659) Avail: NTIS HC A05/MF A01; original German version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 28 Deutsche marks

The solution of the two-dimensional Euler equations by finite volume discretization on unstructured triangular meshes is described. The essential of using unstructured meshes is the possibility to simulate flows around complex geometries, where the generation of structured body-fitted grids is much more expensive. The solution procedure is based on a two-dimensional cell vertex scheme for structured meshes. The components of the procedure were adapted to the requirements of unstructured triangular meshes. The accuracy of the procedure is shown by subsonic and transonic flows around airfoils. The effects of artificial dissipation are investigated and the influence of several acceleration techniques is discussed. ESA

N89-15673# Royal Aerospace Establishment, Farnborough (England).
ON THE SOLUTION OF LAMBERT'S ORBITAL BOUNDARY-VALUE PROBLEM
R. H. Gooding Apr. 1988 57 p
(RAE-TR-88027; RAE-SPACE-670; BR107255; ETN-89-93673)
Copyright Avail: NTIS HC A04/MF A01

A universal solution of Lambert's problem based on the approach of Lancaster et al., (1966) is proposed. Starting formulae for Halley's cubic iteration process, used for evaluation of the unknown parameter, x, at the heart of the approach are proposed; this process always gives highly accurate values of x after three iterations. A FORTRAN-77 computing procedure for a general solution of Lambert's problem was developed, and its three main subroutines are listed. Details of the testing of this procedure are given. A classification of the set of all Lambert problems, and geometric and physical aspects are described. ESA

N89-15674*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
SPECTRAL ELEMENT MULTIGRID. PART 2: THEORETICAL JUSTIFICATION Final Report
Yvon Maday and Rafael Munoz (Santiago Univ., Compostela, Spain) Dec. 1988 31 p Submitted for publication
(Contracts NAS1-18107; NAS1-18605)
(NASA-CR-181761; ICASE-88-73; NAS 1.26:181761) Avail: NTIS HC A03/MF A01 CSCL 12A

A multigrid algorithm is analyzed which is used for solving iteratively the algebraic system resulting from tha approximation of a second order problem by spectral or spectral element methods. The analysis, performed here in the one dimensional case, justifies the good smoothing properties of the Jacobi preconditioner that was presented in Part 1 of this paper. Author

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N89-15675# Tennessee Univ., Knoxville. Dept. of Mathematics.
REMARKS ON THE POSITIVITY OF DENSITIES OF STABLE PROBABILITY MEASURE ON R(d) Report, Apr. 1987 - Apr. 1988
Balram S. Rajput 26 Apr. 1988 14 p
(Grant AF-AFOSR-0136-87; AF Proj. 2304)
(AD-A197920; AFOSR-88-0763TR) Avail: NTIS HC A03/MF A01 CSCL 12B

Let mu be an index alpha, 0 less than alpha less than 2, stable prob. measure on R (d), the d-Euclidean space. Let sigma be the spectral measure of mu on the boundary of the unit sphere of R (D); and assume that the support of sigma is d-dimensional. Using known results about the support of mu, simple proofs are provided for the following two facts about the continuous bounded density f sub mu of mu: (1) If 1 approx. less than alpha less than 2, then f sub mu is positive on R (d); (2) if 0 less than alpha less than 1, then f mu (x) greater than 0 if and only if x belongs to the interior of the translated cone a sub 0 + C sub O, where C sub O is the smallest closed cone generated by the support of sigma, and a sub 0 is the centering element of mu. GRA

N89-15676# Missouri Univ., Columbia. Dept. of Statistics.
BAYESIAN ABILITY ESTIMATION VIA 3PL (THREE-PARAMETER LOGISTIC) WITH PARTIALLY KNOWN ITEM PARAMETERS Technical Report No. 147, 1 Jan. 1987 - 31 Aug. 1988
Robert K. Tsutakawa and Jane Johnson 31 Aug. 1988 36 p
(Contract N00014-85-K-0113; RR04202)
(AD-A198207) Avail: NTIS HC A03/MF A01 CSCL 12C

A standard practice in mental testing is to score individuals using the responses to a set of test items which have previously been calibrated. When latent trait models are employed, the calibration involves estimating parameters of the model using a moderately large sample. The estimated parameters are then assumed to be the true values when the scoring is performed. Even when the assumed model is correct, there are two sources of errors in this process. One is due to the responses of the individuals being scored and the other is due to the error in the calibration. Ignoring the second source could lead to inferential errors, particularly when the calibrating sample is not large. In many areas of testing large samples may not be readily available for calibration. Moreover, disclosure laws commonly require public dissemination of tests, making it necessary to have more items while the pool from which to draw the calibrating sample is limited. This paper deals with the problem of estimating ability when there is uncertainty concerning the item parameters due to the limited size of the calibrating sample. Because of the sequential nature of first calibrating the test and then using it on the target population, the Bayesian paradigm for statistical inference is particularly attractive. GRA

N89-15677# Princeton Univ., NJ.
ON LIFETIMES INFLUENCED BY A COMMON ENVIRONMENT Report, May 1987 - Apr. 1988
Erhan Cinlar, Moshe Shaked, and J. G. Shanthikumar 1987 23 p
(Grants AF-AFOSR-0050-87; AF-AFOSR-0205-84; AF Proj. 2304)
(AD-A198273; AFOSR-88-0760TR) Avail: NTIS HC A03/MF A01 CSCL 12C

Consider the lifelengths T sub 1,...., T sub k of k components subjected to a randomly varying environment. They are dependent on each other because of their common dependence on the environment. The parameters of the model are the distribution of the random process which describes the environment and a set of rate functions which determine the probability law of T sub 1,..., T sub k as a function of the distribution of the environment. We find conditions on the parameters of the model which imply tha T sub 1,..., T sub k are associated. Other conditions which imply that T sub 1,..., T sub k have the multivariate aging properties IHR (increasing hazard rate) and NBU (new better than used) are also described. Also, two such models are compared. In particular, we characterize the parameters of these models so that stochastic ordering between the two vectors of resulting lifetimes can be obtained. GRA

N89-15678# Pittsburgh Univ., PA. Center for Multivariate Analysis.
DETECTION OF CHANGE POINTS USING RANK METHODS
B. Q. Miao and L. C. Zhao Mar. 1988 13 p
(Grant AF-AFOSR-0030-88; AF Proj. 2304)
(AD-A198406; TR-88-02; AFOSR-88-0796TR) Avail: NTIS HC A03/MF A01 CSCL 12A

In this paper, the detection and estimation of change points of local parameters are studied by means of localization procedures and rank statistics. These techniques are also applied to detection and estimation of the change points of scale parameters and that of location parameters of directional data. Change point problem arises in many fields and attracts the attention of many authors. The techniques employed to detect and estimate the change point can generally be classified into two categories: parametric, and nonparametric. Bayesian methods also plays a major role. In this paper, the authors concentrate their attention on the problem of detection of change points of location parameter by localization and rank statistics when data are large. Their method is different from, and has some advantages over, the existing methods, such as CUSUM (cumulative sum) and Csorgo and Horvath's non-sequential nonparametric AMOC (at most one change) procedures. First, localized procedures reduce computation. Second, these detecting and estimating procedures require no moment condition, instead it is only assumed that observed data come from a continuous distribution with a unique median. GRA

N89-15679# Purdue Univ., West Lafayette, IN. Dept. of Statistics.
ADAPTIVE TESTS
K. S. Mak Aug. 1988 16 p
(Contract N00014-88-K-0170; NSF DMS-86-06964; NSF DMS-87-02620A1)
(AD-A199446; TR-88-38) Avail: NTIS HC A03/MF A01 CSCL 12C

The problem of hypothesis testing when the distribution is specified only up to a nuisance parameter is considered. A test is said to be adaptive if it is asymptotically optimal regardless of the value of the nuisance parameter. The exponential rate of convergence to zero of the probability of type II error when the probability of type I error converges to zero exponentially fast at a fixed rate is used as the optimal criterion. A necessary and sufficient condition for the existence of adaptive test is obtained. GRA

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

No abstracts in this category.

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

No abstracts in this category.

70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

N89-15680# Cincinnati Univ., OH. Dept. of Mechanical Engineering.
INSTANTANEOUS SPACE KINEMATICS OF TWO-PARAMETER PLANE PATH Final Report
A. H. Soni, Dev P. Sathyadev, Foo-Ming Fu, Gary Laughlin, Ravi Kulkarni, Nagi G. Naganathan, Mohammad H. Dado, and James Jones Feb. 1988 309 p
(Grant NSF MEA-83-08395)
(PB88-235114; NSF/ENG-88001) Avail: NTIS HC A14/MF A01 CSCL 20C

Fundamental developments of two-parameter tangent-plane motion are presented. Attention is focused on the analysis of the motion of a tangent plane with two degrees of freedom. Properties of motion are identified for finite and higher order motions. The synthesis and analysis of spatial mechanisms for two-parameter tangent-plane envelope generation are discussed. A study of the planar motion of tangent-lines is presented. The synthesis of planar mechanisms to generate given planar curves is shown. Author

N89-15681# California Univ., Berkeley. Lawrence Berkeley Lab. Accelerator and Fusion Research Div.
MAGNETIC CONDITIONING IN SUPERFLUID
S. Caspi Aug. 1988 8 p Presented at the Japan-US Seminar on Basic Mechanisms of Helium Heat Transfer and Related Influence on Stability of Superconducting Magnets, Fukuoka, Japan, 29 Aug. 1988
(Contract DE-AC03-76SF00098)
(DE89-000550; LBL-25795; CONF-8808143-1) Avail: NTIS HC A02/MF A01

Improvements in superconducting magnet technology have reduced to a handful the number of training quenches typical of dipole magnets. The number of training quenches in long (17 m) and short (1 to 2 m) SSC magnets are now about the same (operating at 6.6 tesla and 4.4 K). Yet the steps necessary to totally eliminate training are in the future RandD plans for magnet construction and conductor motion prevention. The accepted hypothesis is that Lorentz forces and poor mechanical properties of superconducting cables are the cause of conductor motion. Conductor motion reduces the stored energy in the cable by converting it into heat. The small amount of heat generated (millijoules) during motion is usually enough to quench the magnet when it is close to short sample. During training, the magnet performance normally improves with the number of quenches. It is not the quench itself that improves magnet performance but rather the fact that once conductor motion has occurred it will probably not repeat itself unless subjected to higher forces. Conditioning is a process that enables the magnet to reduce its stored energy without causing a premature quench. During the conditioning process the magnet is further cooled from its operating temperature of 4.4 K to 1.8 K by converting He I into He II. As a result the magnet is placed in a state where it has excess stability as well as excellent heat transfer capabilities. Although this does not eliminate motion, if the magnet is now cycled to approximately 10 percent above its operating field at 4.4 K (which is above short sample) the excess stability should be enough to prevent quenching and reduce the probability of conductor motion and training once the magnet has been warmed back up to its operating temperature of 4.4 K. DOE

N89-15682# National Academy of Sciences - National Research Council, Washington, DC. Task Group on Fundamental Physics and Chemistry.
SPACE SCIENCE IN THE TWENTY-FIRST CENTURY: IMPERATIVES FOR THE DECADES 1995 TO 2015. FUNDAMENTAL PHYSICS AND CHEMISTRY
1988 107 p
(LC-87-43331; ISBN-0-309-03841-3) Avail: NTIS HC A06/MF A01

The focus of the task group was in two principal areas: relativistic gravitation, which involves testing of the general theory of relativity and microgravity science. A possible long-term research program in physics and chemistry in a microgravity environment and its rationale are outlined. The program is illustrated with examples of experiments, some of which are not in various stages of development and others which are envisioned for later. The common element in the historical perspective of progress in gaining empirical evidence for relativistic gravitation is the close coupling to technical advances in both direct experiments and observational techniques. The space program is expected to play a decisive role in this research. Basic issues, gravitation wave astronomy, current space research in gravitation, expected research prior to 1995, programs after 1995, and technical requirements are discussed. Author

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environmental Pollution.*

N89-15683*# Southwest Research Inst., San Antonio, TX.
INVESTIGATION OF ACOUSTIC EMISSION COUPLING TECHNIQUES Final Report
W. D. Jolly Sep. 1988 83 p
(Contract NAS8-34649; SwRI Proj. 17-7445)
(NASA-CR-183541; NAS 1.26:183541) Avail: NTIS HC A05/MF A01 CSCL 20A

A three-phase research program was initiated by NASA in 1983 to investigate the use of acoustic monitoring techniques to detect incipient failure in turbopump bearings. Two prototype acoustic coupler probes were designed and evaluated, and four units of the final probe design were fabricated. Success in this program could lead to development of an on-board monitor which could detect bearing damage in flight and reduce or eliminate the need for disassembly after each flight. This final report reviews the accomplishments of the first two phases and presents the results of fabrication and testing completed in the final phase of the research program. Author

N89-15684*# Duke Univ., Durham, NC. Dept. of Mechanical Engineering and Materials Science.
AIRCRAFT INTERIOR NOISE REDUCTION BY ALTERNATE RESONANCE TUNING Progress Report, period ending Dec. 1988
Donald B. Bliss, James A. Gottwald, Mark B. Gustaveson, James R. Burton, III, and Craig Castellino Jan. 1989 21 p
(Grant NAG1-722)
(NASA-CR-184668; NAS 1.26:184668) Avail: NTIS HC A03/MF A01 CSCL 20A

Existing interior noise reduction techniques for aircraft fuselages perform reasonably well at higher frequencies, but are inadequate at lower, particularly with respect to the low blade passage harmonics with high forcing levels found in propeller aircraft. A method is being studied which considers aircraft fuselages lines with panels alternately tuned to frequencies above and below the frequency to be attenuated. Adjacent panels would oscillate at equal amplitude, to give equal source strength, but with opposite phase. Provided these adjacent panels are acoustically compact, the resulting cancellation causes the interior acoustic modes to become cut off and therefore be non-propagating and evanescent. This interior noise reduction method, called Alternate Resonance Tuning (ART), is currently being investigated both theoretically and experimentally. This new concept has potential application to reducing interior noise due to the propellers in advanced turboprop aircraft as well as for existing aircraft configurations. This program summarizes the work carried out at Duke University during the third semester of a contract supported by the Structural Acoustics Branch at NASA Langley Research Center. Author

N89-15685*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ACOUSTIC EVALUATION OF THE HELMHOLTZ RESONATOR TREATMENT IN THE NASA LEWIS 8- BY 6-FOOT SUPERSONIC WIND TUNNEL
Laurence J. Heidelberg and Elliot B. Gordon (Sverdrup Technology, Inc., Cleveland, OH.) Jan. 1989 12 p
(NASA-TM-101407; E-4147; NAS 1.15:101407) Avail: NTIS HC A03/MF A01 CSCL 20A

The acoustic consequences of sealing the Helmholtz resonators of the NASA Lewis 8- by 6-Foot Supersonic Wind Tunnel (8x6 SWT) were experimentally evaluated. This resonator sealing was proposed in order to avoid entrapment of hydrogen during tests of advanced hydrogen-fueled engines. The resonators were designed to absorb energy in the 4- to 20-Hz range; thus, this investigation is primarily concerned with infrasound. Limited internal and external noise measurements were made at tunnel Mach numbers ranging from 0.5 to 2.0. Although the resonators were part of the acoustic treatment installed because of a community noise problem their sealing did not seem to indicate a reoccurrence of the problem would result. Two factors were key to this conclusion: (1) A large bulk treatment muffler downstream of the resonators was able to make up for much of the attenuation originally provided by the resonators, and (2) there was no noise source in the tunnel test section. The previous community noise problem occurred when a large ramjet was tested in an open-loop tunnel configuration. If a propulsion system producing high noise levels at frequencies of less than 10 Hz were tested, the conclusion on community noise would have to be reevaluated. Author

N89-15686*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
MEASURED FAR-FIELD FLIGHT NOISE OF A COUNTERROTATION TURBOPROP AT CRUISE CONDITIONS
Richard P. Woodward, Irvin J. Loeffler, and James H. Dittmar Jan. 1989 20 p
(NASA-TM-101383; E-4437; NAS 1.15:101383) Avail: NTIS HC A03/MF A01 CSCL 20A

Modern high speed propeller (advanced turboprop) aircraft are expected to operate on 50 to 60 percent less fuel than the 1980 vintage turbofan fleet while at the same time matching the flight speed and performance of those aircraft. Counterrotation turboprop engines offer additional fuel savings by means of upstream propeller swirl recovery. This paper presents acoustic sideline results for a full-scale counterrotation turboprop engine at cruise conditions. The engine was installed on a Boeing 727 aircraft in place of the right-side turbofan engine. Acoustic data were taken from an instrumented Learjet chase plane. Sideline acoustic results are presented for 0.50 and 0.72 Mach cruise conditions. A scale model of the engine propeller was tested in a wind tunnel at 0.72 Mach cruise conditions. The model data were adjusted to flight acquisition conditions and were in general agreement with the flight results. Author

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N89-15687# Los Alamos National Lab., NM.
BEAR RFQ: BEAM EXPERIMENT ABOARD A ROCKET
D. L. Schrage, L. M. Young, B. M. Campbell, J. H. Billen, J. Stovall, F. A. Martinez, W. L. Clark, W. S. Gibbs, J. D. King, and P. G. OShea 1988 14 p Presented at the International Conference on the Application of Accelerators in Research and Industry, Denton, TX, 7 Nov. 1988 Prepared in cooperation with Grumman Aerospace Corp., Bethpage, NY and GAR Electroformers, Danbury, CT
(Contract W-7405-eng-36)
(DE89-000331; LA-UR-88-3042; CONF-881151-8) Avail: NTIS HC A03/MF A01

Los Alamos National Laboratory, Grumman, and GAR Electroformers have completed the design and fabrication of an electroformed RFQ for the BEAR (Beam Experiments Aboard a Rocket) project. The design of this 1-m-long, lightweight (greater than 55 kg) accelerator incorporates four aluminum vane/cavity quadrants joined by an electroforming process. With the vane and cavity fabricated as a monolithic structure, there are no mechanical RF, vacuum, or structural joints. The completed BEAR RFQ has successfully passed flight qualification and beam transport tests in preparation for the flight, which is scheduled for March 1989. DOE

N89-15688# Princeton Univ., NJ.
THE PHYSICS OF SPIN POLARIZED ATOMIC VAPORS Final Technical Report, 1 Oct. 1986 - 30 Apr. 1988
William Happer 26 May 1988 4 p
(Grant AF-AFOSR-0171-85; AF Proj. 2301)
(AD-A199990; AFOSR-88-1076TR) Avail: NTIS HC A02/MF A01 CSCL 07D

Research efforts are focussed on the study of spin polarized atoms, nuclei and electrons during the period covered by this report. Although this work is 6.1 basic research, it has applications to a number of important Air Force problems. For example, the atomic clocks used on the GPS satellite system operate with optically pumped rubidium absorption cells, very similar to the ones being investigated here. A number of the scientists and engineers working on atomic clocks used by Air Force satellite systems were trained with the support of this grant. We have participated in recent Air Force advisory panels to review concepts for high-energy-density fuels based on spin polarized atoms and molecules. The insights gained from research sponsored by this grant have been very useful in evaluating these ideas. Recent work has focussed on two main areas, the investigation of quadrupolar interactions between spin polarized noble gas nuclei and surfaces and the quantitative investigation of how magnetic field inhomogeneities cause spin relaxation. GRA

N89-15689# Naval Research Lab., Washington, DC.
A NEW CLASS OF CROSS SECTIONS FOR USE IN ATOMIC SCATTERING CALCULATIONS Interim Report
G. P. Mueller 16 Sep. 1988 36 p
(AD-A199542; NRL-MR-6292) Avail: NTIS HC A03/MF A01 CSCL 20E

It is useful to have simple cross sections to represent the interactions between particles when performing transport theory calculations for range, energy deposition, and damage by impinging ions on bulk materials. In this report a number of families of finite range interactions that are simple to generate during such transport calculations are presented. These cross sections have a Thomas-Fermi character at large energy transfers and a wide variation of behavior for small energy transfers. The potentials that correspond to these cross sections are displayed graphically, so that if one has a phenomenologically derived potential between two constituents, one can read off the graphs which family member will give a good representation of that interaction. GRA

N89-15690# Los Alamos National Lab., NM.
SEARCH FOR X-RAYS GENERATED BY COLLISIONLESS MULTIPHOTON PROCESSES
P. H. Y. Lee, D. E. Casperson, and G. T. Schappert 1988 15 p Presented at the 4th Topical Meeting on Short Wavelength Coherent Radiation: Generation and Applications, Cape Cod, MA, 26 Sep. 1988
(Contract W-7405-eng-36)
(DE89-000350; LA-UR-88-3084; CONF-880904-2) Avail: NTIS HC A03/MF A01

We have conducted photon counting experiments to search for X-rays which may be generated by either collisionless multiphoton induced inner-shell processes or bremsstrahlung at high laser irradiance. Using KrF light at an irradiance approximately 3 x 10 to the 17th W/sq cm on low density Xe gas targets, we detect no prompt photons which are characteristic of these processes. DOE

N89-15691# Lawrence Livermore National Lab., CA. Computational Physics Div.
NON-RELATIVISTIC ELECTRON TRANSPORT
Zachary Ha 20 Jul. 1988 19 p
(Contract W-7405-eng-48)
(DE89-000622; UCID-21487) Avail: NTIS HC A03/MF A01

If we want a complete solution for the electron transport properties through a solid, we can set up the problem using all the relevant components of the solid and interactions and solve the time dependent Schroedinger's equation. The first step toward making the problem simple is to come up with a reasonable model of the solid. We will not be able to use a single model to consider all the possible solids. Hence, we will restrict the solid to a simple metal. Let us say that a metal consists of conduction electrons and ion cores. We shall ignore all the rigid structures and will say that the electrons and ions are distributed randomly. There are basically five possible interactions that can occur between an energetic electron (with reasonably low energy) and the solid—electron-conduction e sup-, electron-plasmon, electron-phonon, elastic collisions with ion cores, and ionization. We assume that these interactions are independent of each other and solve for the mean free paths (or cross section) for each interaction. Once we obtain the cross sections (or mean free paths) we will know the relative probability of an interaction with respect to all the other interactions. This result renders the Monte Carlo simulation as a natural way to solve the transport problem. We can randomly select the interaction to occur according to the relative probability of an event. Then we can calculate the energy loss and angular deviation for the electron that suffers the chosen interaction. We repeat the process of randomly selecting the interaction and calculating the energy loss and angular deflection for many electrons until the results get statistically sound. In this paper all the interactions are discussed. Since the full description of any one interaction can be very lengthy, only some important aspects of each interaction are mentioned. DOE

N89-15692*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
MEASUREMENTS AND CALCULATIONS OF THE COULOMB CROSS SECTION FOR THE PRODUCTION OF DIRECT ELECTRON PAIRS BY ENERGETIC HEAVY NUCLEI IN NUCLEAR TRACK EMULSION Final Report
J. H. Derrickson, P. B. Eby, W. F. Fountain, T. A. Parnell, B. L. Dong, J. C. Gregory, Y. Takahashi, and D. T. King (Tennessee Univ., Knoxville.) Nov. 1988 25 p
(NASA-TM-100347; NAS 1.15:100347) Avail: NTIS HC A03/MF A01 CSCL 20H

Measurements and theoretical predictions of the Coulomb cross section for the production of direct electron pairs by heavy ions in emulsion have been performed. Nuclear track emulsions were exposed to the 1.8 GeV/amu Fe-56 beam at the Lawrence Berkeley Laboratory bevalac and to the 60 and 200 GeV/amu O-16 and the 200 GeV/amu S-32 beam at the European Center for Nuclear Research Super Proton Synchrotron modified to accelerate heavy ions. The calculations combine the Weizsacker-Williams virtual quanta method applicable to the low-energy transfers and the Kelner-Kotov relativistic treatment for the high-energy transfers. Comparison of the measured total electron pair yield, the energy transfer distribution, and the emission angle distribution with theoretical predictions revealed a discrepancy in the frequency of occurrence of the low-energy pairs (less than or = 10 MeV). The microscope scanning criteria used to identify the direct electron pairs is described and efforts to improve the calculation of the cross section for pair production are also discussed. Author

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.
For space radiation see *93 Space Radiation.*

No abstracts in this category.

74 OPTICS

Includes light phenomena; and optical devices.
For lasers see *36 Lasers and Masers.*

N89-15693# Oak Ridge National Lab., TN.
THE PRACTICALITY OF HIGH MAGNIFICATION IMAGING BY POSITRON EMISSION
L. D. Hulett, Jr. and S. Pendyala (State Univ. of New York, Fredonia.) 1988 3 p Presented at the 8th International Conference on Positron Annihilation, Ghent, Belgium, 29 Aug. 1988
(Contract DE-AC05-84OR-21400)
(DE88-016806; CONF-8808122-1) Avail: NTIS HC A02

The positron emission microscope has the capability of contrasting areas having high concentrations of monatomic vacancies and other defects. Since the positrons traveling through the specimen will have energies of the same magnitude as that of valence electrons, image contrast will be sensitive to the chemistry of the specimen. In the near future resolutions of 10 nm or lower will be achieved. Whether or not optical aberrations will permit one atom resolution is not clear. For one atom resolution to be obtained positron emission fluxes must be brightness enhanced to 10 to the 11th power/sec/sq cm or greater. DOE

N89-15694# Pennsylvania State Univ., University Park. Dept. of Electrical Engineering.
STUDIES OF OPTICAL WAVE FRONT CONJUGATION AND IMAGING PROPERTIES OF NEMATIC LIQUID CRYSTAL FILMS Final Report, 15 Aug. 1984 - 14 May 1988
Iam-Choon Khoo 30 Jun. 1988 136 p
(Grant AF-AFOSR-0375-84; AF Proj. 2305)
(AD-A197916; AFOSR-88-0741TR) Avail: NTIS HC A07/MF A01 CSCL 20F

Optical nonlinearities of liquid crystals owing to laser induced molecular reorientation or laser induced thermal index change, were studied in the context of optical wave mixings and real time imagings. The basic mechanisms and the dynamics of the nonlinearities were studied in detail in theories, and in experiments using lasers of various time scales and temporal characteristics. Quantitative documentation of nanosecond laser induced thermal grating was performed for the first time, and further established the optical images to visible images via real time optical wave mixing processes was also demonstrated. The capability of optical four wave mixing to generate amplified reflection and self-oscillation in nematic liquid crystal film was also demonstrated for the first time. Such a process will be useful for image processing as well as laser oscillator adaptive optics applications. New optical intensity switching effects and optical beam amplifications and infrared laser wave mixings were also experimentally demonstrated, that will find application in optical switching, image processing and power self limiting devices. GRA

N89-15695# School of Aerospace Medicine, Brooks AFB, TX.
ELECTRO-OPTIC PERFORMANCE OF PLZT (LANTHANUM-MODIFIED LEAD ZIRCONATE TITANATE) LENSES Final Report, Oct. 1987 - Feb. 1988
Randall L. Lindsey Sep. 1988 21 p
(AD-A199897; USAFSAM-TR-88-13) Avail: NTIS HC A03/MF A01 CSCL 20F

The EDU-2/P PLZT Thermal/Flash Protective Device (TFPD)

furnished for testing and measuring the electro-optic performance yielded the following results: (1) switching delay time was 16 microseconds average; (2) average time to achieve an optical density of 3.0 was 147 microseconds; (3) maximum optical density achieved was 4.1, corresponding to a .0079 percent transmission; (4) photopic and scotopic luminous transmittances were measured as 18.6 and 18.9 percent, respectively, in the open state. This report includes graphics illustrating all the results previously mentioned. In addition, two best fit functions were generated from the collected data which model the protective mode response of the PLZT Goggle to within a 0.249 percent RMS error. GRA

N89-15696# City Coll. of the City Univ. of New York. Dept. of Electrical Engineering.
OPTICAL ACQUISITION, IMAGE AND DATA COMPRESSION Final Report, Jun. 1987 - Jul. 1988
George Eichmann 30 Jul. 1988 100 p
(Grant AF-AFOSR-0212-85; AF Proj. 2305)
(AD-A199993; CCEE-447222-3; AFOSR-88-0988TR) Avail: NTIS HC A05/MF A01 CSCL 12F

A new conditional symbolic substitution rule for modified signed-digit arithmetic computation is introduced. Using this substitution rule, the numbers to be added or subtracted are first replaced by a pair of new equivalent strings, which in a second step are then subject to another substitution to generate both the addition or substitution result and its complement. For an optical implementation, a holographic content-addressable memory is used. Correspondingly, the input encoding, the logic reduction, and the optical processing techniques are described. An optical isochronous array processing method is proposed. An optical isochronous array processor (OIAP) is a local regularly interconnected processing network that employs an array of identical processing elements. In an OIAP, incoming, isochronous data are parallel processed in a fashion much like a propagating electromagnetic wavefront. For the various applications, the OIAP processing elements and their interconnections can be different. In this paper, various all-optical OIAP elements are considered. Applications ranging from optical binary number multiplication preprocessing to optical matrix algebra as well as to optical residue arithmetic are presented. GRA

N89-15697# Washington State Univ., Pullman. Dept. of Physics.
OBSERVATION OF BREWSTER ANGLE LIGHT SCATTERING FROM AIR BUBBLES RISING IN WATER Technical Report No. 7, 15 Jul. 1987 - 15 Aug. 1988 M.S. Thesis
Stefan M. Baumer 25 Aug. 1988 117 p
(Contract N00014-85-C-0141)
(AD-A199582) Avail: NTIS HC A06/MF A01 CSCL 20F

Air bubbles rising freely through distilled water were illuminated by laser light with incident polarization of the electric field parallel to the plane of incidence. The radii a of the bubbles investigated were from 50 to 100 micrometers. At Brewster's angle of incidence i sub B = arctan (m) = 36.9, the Fresnel reflection coefficient vanishes, where m is the relative index of refraction for a water-air interface, m = 0.75. Therefore a minimum in scattered intensity should be observed at the Brewster scattering angle theta sub B = 180 deg - 2i sub B = 106.2 deg. Furthermore interference patterns caused by different classes of rays should change drastically for angles around Brewster scattering angle theta sub B. Experiments were done to detect these two phenomena by photographing the scattering light. The scattered intensity as a function of angle was inferred by scanning the photographs with a microdensitometer. To confirm the experimental results, they were compared with Mie theory calculation for scattering from spherical bubbles. Features of the scattering pattern due to ray interference could be understood using geometrical optics. The experiment confirmed that the observed features of the scattering pattern near theta sub B are those predicted of a bubble having a clean surface. GRA

N89-15698# Los Alamos National Lab., NM.
STIMULATED BRILLOUIN SCATTERING IN SOLID AEROSOLS
S. M. Chitanvis Aug. 1988 18 p Presented at the CRDEC Scientific Conference on Obscuration and Aerosol Research, Aberdeen, MD, 22 Jun. 1988
(Contract W-7405-eng-36)
(DE89-000390; LA-UR-88-2876; CONF-8806239-1) Avail: NTIS HC A03/MF A01

We estimate the differential scattering cross-section due to SBS in a glass bead which is much larger than the wavelength of a high energy laser beam which irradiates it. We consider three possible scenarios: neither the incident nor the Stokes wavelength is on a Mie resonance; only the Stokes wavelength is on resonance; and the incident wavelength and the Stokes wavelength are on a Mie resonance. For the first two cases, we find that the SBS scattering cross-section is extremely small compared to the geometric/Mie cross-section. It follows as a corollary that SBS in a glass bead will be insufficient to shatter it in these two cases. In the last case, it is quite possible that due to the buildup of high fields on-resonance within the spherical bead, the bead might be shattered. The chance of such an event occurring in a polydisperse distribution of spherical beads is generally not expected to be very high. DOE

N89-15699# Lawrence Livermore National Lab., CA.
A FAST RADIATION-TO-COHERENT LIGHT CONVERTER
C. L. Wang, J. E. Flatley, P. H. Stewart, N. Bar-Chaim, K. Y. Lau, I. Ury, R. M. Baltrusaitis, T. J. Davies, B. A. Davis, and S. G. Iversen (Edgerton, Germeshausen and Grier, Inc., Goleta, CA.) et al Sep. 1988 7 p Presented at the SPIE O-E Lase: International Symposium and Exhibition on Fiber Optics, Optoelectronics and Laser Applications, Boston, MA, 6 Sep. 1988
(Contract W-7405-eng-48)
(DE89-001218; UCRL-98044; CONF-8809105-8) Avail: NTIS HC A02/MF A01

A radiation-to-coherent light converter (RCLC) is developed with a monolithically integrated semiconductor chip, consisting of a chromium-doped GaAs photoconductor detector modulating the laser diode, which has been biased above the lasing threshold, thus converting a radiation pulse to an electric pulse and then to a light pulse. The laser pulse is then transmitted to a fast recorder through a high-bandwidth optical fiber. In the absence of a single-step X-ray pumped laser, this converter appears to be the first integrated device that can efficiently convert X-ray flux into coherent light. This device has been tested successfully with the 50-ps electron beams of a 17-MeV linear accelerator and with 50-ns X-ray pulses from a Z-pinch plasma source. DOE

N89-15700# Lawrence Livermore National Lab., CA.
ULTRAFAST FRAMING OF X-RAY IMAGES
D. G. Stearns, J. D. Wiedwald, B. M. Cook, R. L. Hanks, and O. L. Landen 1988 10 p Presented at the 32nd International Technical Symposium on Optical and Opto-Electronic Applied Sciences and Engineering, San Diego, CA, 14 Aug. 1988
(Contract W-7405-eng-48)
(DE89-001289; UCRL-99533; CONF-880887-23) Avail: NTIS HC A02/MF A01

The interaction pulsed, high-intensity (I greater than 10 to the 14th W/sq cm) laser light with a solid target typically produces a dense plasma that radiates significantly in the soft X-ray region of 0.1 to 10 keV. Important information concerning the dynamics of the laser-produced plasmas can be obtained through time-resolved imaging and spectroscopy of the X-ray emission. In particular, high-resolution X-ray imaging provides a direct means of studying the evolution of temperature and density profiles of the plasma, as well as the hydrodynamics which govern its expansion. Since the expansion velocities can be in excess of 10 to the 7th cm/s, the frame duration of the time-resolved image must be less than 100 ps to avoid significant blurring. In addition, the laser-produced plasmas are usually small and have large density gradients, particularly at early times. Consequently, it is desirable that the imaging system be able to resolve structure on a spatial scale of approx. 1/10 micrometer. In this paper we describe the development of a high resolution X-ray framing camera (XFC) to be used to image the soft X-ray emission from laser-produced

plasmas on a picosecond timescale. The XFC generates a single frame with 50 ps temporal resolution 22 m spatial resolution at the image plane and real time readout. The camera is optically triggered, resulting in jitter-free synchronization of the frame time with the laser experiment, making it possible to integrate multiple shots with no loss of temporal resolution. One of the first applications of the XFC will be to image the dynamic implosion of micro-balloon fuel pellets for laser fusion using the Nova 10-beam laser system. DOE

N89-15701# Lawrence Livermore National Lab., CA.
MANUFACTURE, STRUCTURE AND PERFORMANCE OF W/B4C MULTILAYER X-RAY MIRRORS
A. F. Jankowski and D. M. Makowiecki Jun. 1988 14 p
Presented at the 32nd International Technical Symposium on Optical and Opto-Electronic Applied Sciences and Engineering, San Diego, CA, 14-19 Aug. 1988
(Contract W-7405-eng-48)
(DE89-001503; UCRL-98255; CONF-880887-25) Avail: NTIS HC A03/MF A01

One of the most important considerations in the design and manufacture of multilayer mirrors is material compatibility. Ideally, the materials selected should not chemically react or interdiffuse thereby avoiding the formation of second phases, enhancing the smoothness of the deposited layer interface and hence enhancing the reflectivity of the optic. It is also possible to increase the reflectivity by decreasing the thickness of the more absorbing layers and increasing the thickness of the less absorbing layers, for any given periodicity. The optimum thickness of each layer, however, is rigorously related to the specific materials as well as the X-ray wavelength being used. The transparency of the spacing (low absorption) layers can thus be augmented by materials of low absorption that are thermodynamically stable and which deposit in a smooth continuous fashion. Whereas the use of boron as opposed to carbon as a spacing material provides lower absorption, it is typically inferior in providing as low as interfacial roughness in multilayer form. For example, in rhenium-tungsten/carbon multilayers, produced by evaporation, a typical roughness of less than 0.3 nm is obtained versus 0.7 nm for rhenium-tungsten/boron multilayers. Initial findings with B4C layers indicate deposits which show layer smoothness exceeding those containing carbon with the advantage of greater stability, lower absorption and therefore greater reflectivity. The manufacture, microstructure and reflectivity of W/B4C multilayers will be the focus of this presentation. DOE

N89-15702# Lawrence Livermore National Lab., CA.
SUBSURFACE DAMAGE IN OPTICAL MATERIALS: ORIGIN, MEASUREMENT AND REMOVAL Summary Report
P. Paul Hed, David F. Edwards, and Janet B. Davis 1988 9 p
Presented at the Optical Fabrication and Testing Workshop, Santa Clara, CA, 2 Nov. 1988 Submitted for publication
(Contract W-7405-eng-48)
(DE89-001221; UCRL-99548; CONF-881187-1) Avail: NTIS HC A02/MF A01

The detection, measurement and removal of subsurface damage is a major effort of the LLNL Optical Sciences and Engineering Group. We will describe and show examples of three methods we are currently using to detect and measure the depth of damage in glasses and crystalline materials: taper polishing and etching, constancy of chemical etch rate, and small specimen fracture. In addition, results will be given to show that the depth of damage can often be approximated from the surface roughness and Young's modulus. DOE

N89-15703# EG and G Energy Measurements, Inc., Los Alamos, NM.
THE MIDLAND FIBER-OPTIC ANALOG TRANSMISSION SYSTEM (FATS) DEVELOPMENT PROJECT
J. S. Baumgart, R. Anaya, and G. Morris Jul. 1988 135 p
(Contract DE-AC08-88NV-10617)
(DE88-014118; EGG-10617-5007) Avail: NTIS HC A07

This report was written to document the overall effort related to the development and testing of the various components comprising the fiber optic analog transmission system (FATS) and to the validation of the FATS itself. The overall project was approached as a joint effort between the Los Alamos National Laboratory; the Atomic Weapons Research Establishment (AWRE); and EG and G Energy Measurements. The ultimate goal of the project was to develop a system, based on laser diodes and a streak camera system, to measure alpha. Although the FATS was not fielded on the MIDLAND event, in the course of the project we did in fact answer technology questions identified on previous experiments and develop a better understanding of system needs. We hope that the information contained in this report will provide a basis for planning future experiments, as well as defining the direction for additional laboratory measurements. DOE

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N89-15704 Oxford Univ. (England).
STEADY, COLLISIONLESS PLASMA FLOW ALONG A MAGNETIC FIELD Ph.D. Thesis
R. C. Bissell 1986 187 p
Avail: Univ. Microfilms Order No. BRD-81472

The mathematical modeling of a one dimensional, steady-state, collisionless plasma in a varying magnetic field is described. The plasma is enclosed, over a finite volume, between two electrically insulated walls. It originates from an extended source, where the magnetic field is constant, and then enters a simple magnetic mirror where there is no source. Initially, the magnetic field is assumed to be constant everywhere. A cold-ion and a warm-ion, non-Maxwellian, kinetic theory model (Emmert) are described. A kinetic model with a Maxwellian source is formulated and solved. The results differ from those found; in particular, the boundary electric field is infinite. It is then compared to the warm-ion fluid model. The plasma density and ion-fluid speed results are in reasonable agreement, but large differences occur in the ion temperature and ion-heat flux becasue of the inaccuracy of the fluid model's closure condition. The magnetic mirror is then incorporated, and a comparatively simple kinetic theory model of the whole system is developed. It extends the work of Bailey and Emmert by including an extenced source region and trapped ions. The major conclusions are that a shock occurs downstream of the mirror throat and that a radial electric field will occur in any real magnetic mirror system, causing an E x B drift.
Dissert. Abstr.

N89-15705 Harvard Univ., Cambridge, MA.
ANALYTICAL AND NUMERICAL INVESTIGATIONS OF LINEAR AND NONLINEAR MAGNETOHYDRODYNAMIC WAVE PROPAGATION Ph.D. Thesis
Yu-Qing Lou 1987 195 p
Avail: Univ. Microfilms Order No. DA8806106

Four relatively independent, magnetohydrodynamic (MHD) wave problems and their relevance to astrophysical processes were investigated. The damping of the Alfven mode in stochastic astrophysical fluids is considered. The properties of coherent small-amplitude Alfven waves propagating along a strong mean background magnetic field in a turbulent plasma is investigated by applying the projection operator technique. Numerical simulation of two-dimensional, unsteady, ideal MHD equations by the method of characteristics is presented. The numerical scheme is described in detail and the numerical results are compared with analytic solutions. The two-dimensional, global, nonlinear MHD waves of large scale were investigated in a zonal magnetic field on the surface of a rotating sphere. Two kinds of finite-amplitude MHD waves propagating in the aximuthal direction relative to the uniformly rotating atmosphere were obtained. Standing MHD wave modes for a perfectly conducting but viscid magnetofluid was investigated in a gravitationally stratified magnetic flux tube. Numerical results were obtained for three series of modes in an

isothermal flux tube: Alfvenic, quasi-fast, and quasi-slow. The physical nature of the three MHD eigenmodes were illustrated using three approximate, charcteristic dispersion relations. The relevance of this problem to umbral oscillations in sunspots is discussed. Dissert. Abstr.

N89-15706# Lawrence Livermore National Lab., CA.
THE TILT MODE, TURBULENCE AND TRANSPORT IN FIELD-REVERSED CONFIGURATIONS
H. R. Lewis, D. C. Barnes, R. C. Bishop, N. A. Krall, Z. Mikic, R. D. Milroy (Spectra Technology, Inc., Bellevue, WA.), A. A. Mirin, A. G. Sgro, D. E. Shumaker, and J. L. Staudenmeier et al 1988 10 p Presented at the 12th International Conference on Plasma Physics and Controlled Nuclear Fusion Research, Nice, France, 12 Oct. 1988
(Contract W-7405-eng-36)
(DE88-016220; LA-UR-88-2708; CONF-881015-6; IAEA-CN-50/C-5-15) Avail: NTIS HC A02/MF A01

An outstanding theoretical problem of great importance in research on field-reversed configurations (FRCs) is the explanation of the observed stability of FRCs to the internal tilt mode. For example, in the Los Alamos FRX-C experiment, FRCs showed no evidence of the internal tilt mode during experimental lifetimes of up to 300 microns, which is over an order of magnitude longer than the expected ideal MHD growth time. Finite-Larmor-Radius (FLR) theory is inappropriate for the FRC configuration and the observed stability has not been explained by FLR theory. We are engaged in MHD and kinetic studies of the tilt mode that are aimed at explaining the observed stability in FRC experiments. These studies are within the contexts of two physical models: resistive MHD and the Vlasov-fluid model (collisionless ions, massless fluid electrons). Computer codes that implement both linearized and fully nonlinear versions of these models are being used. Our results do not yet provide an adequate explanation of the observed stability, although a strongly stabilizing tendency due to kinetic ion effects has been observed. The effects of plasma rotation appear to be unimportant. It seems most likely that a combination of profile effects, ion kinetic effects and nonlinear effects will be required to understand the gross stability of FRCs. The theoretical and simulational evidence for interior turbulence in FRCs is overwhelming. For investigating the important subject of turbulence and transport in FRCs, we use both analytic studies and numerical simulation. A conclusion of our investigations is that FRC transport laws should not be based on lower-hybrid-drift (LHD) modes localized near the separatrix, but should be based on low-frequency turbulence occurring throughout the FRC profile. DOE

N89-15707# Krall Associates, Del Mar, CA.
ANOMALOUS TRANSPORT IN THE FIELD REVERSED CONFIGURATION Final Report
N. A. Krall and S. Hamasaki (JAYCOR, San Diego, CA.) Sep. 1988 23 p
(Contract DE-FG03-87ER-53260)
(DE88-017280; DOE/ER-53260/T1) Avail: NTIS HC A03/MF A01

This report describes the result of DOE Contract DE-FG03-87ER53260, a project to study anomalous transport in the Field Reversed Configuration (FRC). The work was both analytic and numerical. The analytic work produced transport coefficients appropriate for various local regions of the FRC. The numerical work investigates what differences arise in loss rates or profiles (r,z) due to a local treatment as opposed to a global treatment (mode structure neglected). The FRC operates in a parameter space distinct from other plasma confinement geometries, namely, high beta (equivalent to 4 Pi nT/B squared), no shear, and an internal field null. Further, the magnetic geometry is characterized by having three spatially distinct regions: race track region, moderate beta mirror region, and high beta mirror region. A recent stability calculation recognized that different stability behavior would be expected in each of these regions, and solved the dispersion matrix to find three distinct unstable modes in the three distinct regions. In the present paper, we calculate the transport produced by the three low frequency modes, and obtain both global transport scaling estimates and local transport coefficients, with a numerical demonstration of the effect of this localization. DOE

N89-15708# Texas Univ., Austin. Inst. for Fusion Studies.
MHD ALFVEN STABILITY IN IGNITED TOROIDAL PLASMAS
G. Y. Fu, J. W. VanDam, M. N. Rosenbluth, D. W. Ross, Y. Z. Zhang, H. L. Berk, S. M. Mahajan, C. Z. Cheng, R. L. Miller, and X. H. Wang (Columbia Univ., New York, NY.) Oct. 1988 17 p Presented at the 12th International Conference on Plasma Physics and Controlled Nuclear Fusion Research, Nice, France, 12-19 Oct. 1988
(Contracts DE-FG05-80ET-53088; DE-AC02-76CH-03073; DE-AC03-85ER-80229; DE-FG02-86ER-53222)
(DE89-001071; DOE/ET-53088/346; IFSR-346; IAEA-CN-50/D-4-11) Avail: NTIS HC A03/MF A01

The presence of fusion-product alpha particles in an ignition tokamak can significantly modify the stability behavior of the burning plasma. In this paper, the effects of toroidicity are retained in a theoretical description of two global-type shear Alfven modes that can be destabilized by the alpha particles. Toroidicity can lead to stabilization of the global shear Alfven eigenmode, but it induces a shear Alfven gap eigenmode whose growth rate is even larger, although these modes may saturate nonlinearly. The stabilizing influence of highly energetic particles on low-frequency MHD ballooning and internal kink modes is also explored; in particular, ion diamagnetic frequency effects may stabilize fishbone oscillations, as has been observed with monster sawteeth in JET with ICRF heating. DOE

N89-15709# Lawrence Livermore National Lab., CA.
ACCELERATION OF COMPACT TOROID PLASMA RINGS FOR FUSION APPLICATIONS
C. W. Hartman, W. L. Barr, J. L. Eddleman, M. Gee, J. H. Hammer, S. K. Ho, B. G. Logan, D. J. Meeker, A. A. Mirin, and W. M. Nevins 26 Aug. 1988 15 p Presented at the 12th International Conference on Plasma Physics and Controlled Nuclear Fusion Research, Nice, France 12 Oct. 1988 Prepared in cooperation with General Atomic Co., San Diego, CA and California Univ., Berkeley Submitted for publication
(Contract W-7405-eng-48)
(DE88-017165; UCRL-98504; CONF-881015-12) Avail: NTIS HC A03/MF A01

We describe experimental results for a new type of collective accelerator based on magnetically confined compact torus (CT) plasma rings and discuss applications to both inertial and magnetic fusion. We have demonstrated the principle of CT acceleration in the RACE device with acceleration of 0.5 mg ring masses to 400 km/s and 0.02 mg ring masses to 1400 km/s at greater than or equal to 30 percent efficiency. Scaling the CT accelerator to the multi-megajoule level could provide an efficient, economical driver for inertial fusion (ICF) or magnetically insulated inertial fusion. Efficient conversion to X-rays for driving hohlraum-type ICF targets has been modeled using a radiation-hydrodynamics code. At less demanding conditions than required for ICF, a CT accelerator can be applied to fueling and current drive in tokamaks. Fueling is accomplished by injecting CTs at the required rate to sustain the particle inventory and at a velocity sufficient to penetrate to the magnetic axis before CT dissolution. Current drive is a consequence of the magnetic helicity content of the CT, which is approximately conserved during reconnection of the CT fields with the tokamak. Major areas of uncertainty in CT fueling and current drive concern the mechanism by which CTs will stop in a tokamak plasma and the effects of the CT on energy confinement and magnetic stability. Bounds on the required CT injection velocity are obtained by considering drag due to emission of an Alfven-wave wake and rapid reconnection and tilting on the internal Alfven time scale of the CT. Preliminary results employing a 3-D, resistive MHD code show rapid tilting with the CT aligning its magnetic moment with the tokamak field. Requirements for an experimental test of CT injection and scenarios for fueling a reactor will also be discussed. DOE

N89-15710# Stanford Univ., CA. High Temperature Gasdynamics Lab.
FUNDAMENTAL PROCESSES IN PARTIALLY IONIZED PLASMAS Final Scientific Report, 1 Feb. 1983 - 31 Jan. 1988
C. H. Kruger, M. Mitchner, and S. A. Self 15 May 1988 153 p
(Grant AF-AFOSR-0108-83; AF Proj. 2301)
(AD-A198627; AFOSR-88-0933TR) Avail: NTIS HC A08/MF A01 CSCL 20I

This research is directed to three major areas: recombination in molecular plasmas, discharge effects (plasma electrode interaction) and interaction of discharges and fluid dynamics. Recombination and ionization are fundamental processes that play a role in nearly all applications and natural phenomena that involve partially ionized plasmas. Under the present program experiments have been designed and theoretical analyses conducted to obtain a better knowledge of the rates of electron recombination in the presence of molecular species. Studies were undertaken of the near-electrode region and the processes by which current is transferred in the region between a plasma and an electrode. A study of the interaction of discharges and fluid dynamics has measured the significant secondary flows and their effects caused by the interaction of a magnetic field with a current-carrying plasma. GRA

N89-15711# United Technologies Research Center, East Hartford, CT.
THEORETICAL STUDIES OF KINETIC MECHANISMS OF NEGATIVE ION FORMATION IN PLASMAS Final Report, 1 Jun. 1985 - 31 May 1988
H. H. Michels Jun. 1988 54 p
(Contract F49620-85-C-0095)
(AD-A199994; UTRC/R88-927258; AFOSR-88-0980TR) Avail: NTIS HC A04/MF A01 CSCL 07D

This technical program constitutes a theoretical research investigation of the kinetic mechanisms of negative ion formation in plasmas. This study was directed toward elucidating the mechanisms of the most important volume dependent reactions that occur in hydrogen-ion, H-(D-) source devices, primarily of the Belchenko-Dimov-Dudnikov (BDD) type and toward evaluating other light negative anions, such as Li-, as possible sources. A primary goal of this research program was to identify the most important reactions leading to negative ion production or destruction and to estimate these reaction cross sections and product branching ratios. A further goal was to explore new chemical sources for the production of light mass negative atomic ions. The results of this program furnish data and provide direction for more detailed investigations into the kinetics of both gas phase and gas-surface reaction rates of importance in ion source devices and provide input for reliable modeling of such systems. This investigation was carried out using quantum mechanical methods. Both ab initio and density functional approaches were employed in these studies. GRA

N89-15712# California Univ., Los Angeles. Dept. of Physics.
EXPERIMENTAL STUDY OF PLASMOID FORMATION AND TRANSPORT BY MEANS OF MOVING MAGNETIC FIELDS Final Technical Report, 16 Sep. 1986 - 15 Dec. 1987
Andras Kuthi, Helio Zwi, and Alfred Y. Hong 12 Feb. 1988 19 p
(Contract F49620-86-C-0107)
(AD-A200005; AFOSR-88-1062TR) Avail: NTIS HC A03/MF A01 CSCL 20I

Driven, steady-state, stable plasmoids have been generated in an external axial magnetic field by rotating magnetic fields. The plasma equilibrium was stable for any value of beta between zero and unity. The plasmoid was free-standing, well removed from the RF antenna and the limiters. Limits to plasmoid stability have been investigated, and it was found that the antenna near-fields can effectively stabilize gross Magneto-Hydrodynamic modes through the RF ponderomotive force when the rotating field strength was higher than the value necessary for full field penetration. Decay of the driven diamagnetic current and thus the plasmoid has been investigated and it was found, that the resistive current decay was responsible for an induced azimuthal electric field producing the rapid, ion inertia limited E x B radial expansion. GRA

N89-15713# Air Force Weapons Lab., Kirtland AFB, NM.
EXPERIMENTAL STUDIES OF COAXIAL PLASMA GUN CURRENT Final Report, Nov. 1985 - Dec. 1987
David W. Price Sep. 1988 404 p
(AD-A199564; AFWL-TR-88-79) Avail: NTIS HC A18/MF A01 CSCL 20I

This investigation examines a coaxial plasma gun, its plasma sheath currents and related behavior. Plasma gun applications are determined by the plasma behavior. The PUFF capacitor bank (72 micro F, 29 nH, 120 kV) drives the plasma gun using a deuterium fill gas. The gas breakdown site is isolated from the dielectric/vacuum interface in the AFWL system. Two gas valves deliver gas in the system. The first delivers gas from the gun breech and the second optional valve delivers gas to the gun muzzle. Currents and voltages are measured by Rogowski coils, B-dot probes and capacitive voltage probes. Silver activation neutron detectors monitor fusion product neutrons. In the snowplow mode, the plasma sheath is thin with a sharp current rise and drop. In the deflagration mode, the plasma sheath is diffuse over a large volume. Our system operated in a transition mode between the snowplow and deflagration modes with early snowplow behavior and late deflagration behavior. Experimental results are compared to four theories for plasma sheath velocities: the Alfven collisionally limited model, the Rosenbluth model, the Fishbine saturated model and a single particle drift model. GRA

N89-15714# Los Alamos National Lab., NM.
THE REVERSED-FIELD PINCH AS A POLOIDAL-FIELD-DOMINATED, COMPACT, HIGH-POWER-DENSITY FUSION SYSTEM
R. A. Krakowski 1988 8 p Presented at the Fusion Power Associates Annual Meeting and Symposium on the Creation of Compact, High Power Density Plasmas, Santa Fe, NM, 6 Sep. 1988
(Contract W-7405-eng-36)
(DE89-000377; LA-UR-88-2923; CONF-880967-3) Avail: NTIS HC A02/MF A01

This paper discusses the feasibility of reversed-field pinch devices as future thermonuclear reactors. Safety, cost, ion temperatures, Lawson numbers, and power densities are reviewed for these types of devices. DOE

N89-15715# Los Alamos National Lab., NM.
THE HIGH DENSITY Z-PINCH
G. H. McCall 1988 15 p Presented at the 3rd Latin-American Workshop on Plasma Physics, Santiago, Chile, 18 Jul. 1988
(Contract W-7405-eng-36)
(DE89-000382; LA-UR-88-2912; CONF-8807111-1) Avail: NTIS HC A03/MF A01

During the past few years techniques have been developed for producing pinches in solid deuterium. The conditions which exist in these plasmas are different from those produced earlier. The pinch is formed from a fiber of solid deuterium rather than from a low density gas, and the current is driven by a low impedance, high voltage pulse generator. Because of the high initial density, it is not necessary to compress the pinch to reach thermonuclear conditions, and the confinement time required for energy production is much shorter than for a gas. Results, which have been verified by experiments performed at higher current were quite surprising and encouraging. The pinch appeared to be stable for a time much longer than the Alfven radial transit time. It is argued that the pinch is not strictly stable, but it does not appear to disassemble in a catastrophic fashion. It appears that there may be a distinction between stability and confinement in the high density pinch. In the discussion below the status of the high density Z-pinch experiments at laboratories around the world is presented, and some of the calculational and experimental results described. Remarks are confined to recent work on the high density pinch. DOE

N89-15716# Oak Ridge National Lab., TN.
DEVELOPMENT OF A TWO-STAGE LIGHT GAS GUN TO ACCELERATE HYDROGEN PELLETS TO HIGH SPEEDS FOR PLASMA FUELING APPLICATIONS
S. K. Combs, S. L. Milora, C. R. Foust, M. J. Gouge, D. T. Fehling, and D. O. Sparks 1988 20 p Presented at the 35th National Vacuum Symposium and 4th International Laser Science Conference, Atlanta, GA, 2 Oct. 1988
(Contract DE-AC05-84OR-21400)
(DE89-000427; CONF-881002-8) Avail: NTIS HC A03/MF A01

The development of a two-stage light gas gun to accelerate hydrogen isotope pellets to high speeds is under way at Oak Ridge National Laboratory. High velocities are desirable for plasma fueling applications, since the faster pellets can penetrate more deeply into large, hot plasmas and deposit atoms of fuel directly in a larger fraction of the plasma volume. In the initial configuration of the two-stage device, a 2.2-l volume provides the gas to accelerate a 25.4-mm-diam piston in a 1-m-long pump tube; a burst disk or a fast valve initiates the acceleration process in the first stage. As the piston travels the length of the pump tube, the downstream gas is compressed (to pressures up to 2600 bar) and thus is driven to high temperature (approx. 5000 K). This provides the driving force for acceleration of a 4-mm pellet in a 1-m-long gun barrel. In preliminary tests using helium as the driver in both stages, 35-mg plastic pellets have been accelerated to speeds as high as 3.8 km/s. Projectiles composed of hydrogen ice will have a mass in the range from 5 to 20 mg. However, the use of sabots to encase and protect the cryogenic pellets from the high peak pressures will probably be required to realize speeds of approx. 3 km/s or greater. The experimental plan includes acceleration of hydrogen isotopes as soon as the gun geometry and operating parameters are optimized; theoretical models are being used to aid in this process. The hardware is being designed to accommodate repetitive operation, which is the objective of this research and is required for future applications. DOE

N89-15717# Sandia National Labs., Albuquerque, NM.
TRAPPING AND IONIZATION BY PLASMA ELECTRONS IN IFR BEAM PROPAGATION IN THE PRESENCE OF AN AXIAL FIELD
I. R. Shokair 1988 9 p Presented at the DARPA/SDIO Services Annual Propagation Review, Newport, RI, 12 Sep. 1988
(Contract DE-AC04-76DP-00789)
(DE89-000454; SAND-88-2414C; CONF-8809149-2) Avail: NTIS HC A02/MF A01

As a relativistic electron beam propagates into a plasma channel in the ion-focused regime (IFR), the plasma electrons are ejected under the influence of the beam electrostatic field. If there is an axial magnetic field, it is possible for the plasma electrons to be trapped on orbits within the drift tube radius. These trapped electrons are highly energetic (compared to ionization energies) and thus for long pulse beams it is possible that the channel density would vary as a function of time due to ionization by the trapped electrons. It is also possible that plasma electrons trapped in the vicinity of the beam would cause electron-electron instabilities. Trapping and ionization by plasma electrons is considered in this paper. First, we derive a transcendental equation for the electron trapping radius in terms of the beam parameters and the external field. We then find an expression for the time-averaged plasma electron density profile in the presence of the relativistic beam. Finally, we estimate the ionization rate by these electrons. In the following analysis, it is assumed that only the beam electrostatic forces act on the plasma electrons; that is, forces due to channel ions and electrons are neglected. This limits the applicability of the analysis to problems with small neutralization fractions. We also neglect electrodynamic effects. DOE

N89-15718# California Univ., San Diego, La Jolla. Dept. of Physics.
ADVANCES IN THE THEORY OF ION-TEMPERATURE-GRADIENT-DRIVEN TURBULENCE
H. Biglari, P. H. Diamond, M. N. Rosenbluth, R. E. Waltz, R. R. Dominguez, P. W. Terry, N. Mattor, P. Lyster, J. N. Leboeuf, and B. A. Carreras (Oak Ridge National Lab., TN.) 1988 14 p Presented at the 12th International Conference on Plasma Physics and Controlled Nuclear Fusion Research, Nice, France, 12 Oct. 1988
(Contracts DE-AC05-84OR-21400; DE-FG03-88ER-53275; DE-FG03-85ER-53199; DE-AC03-84ER-53158)
(DE89-001189; IAEA-CN-50/D-4-8; CONF-881015-19) Avail: NTIS HC A03/MF A01

The theory of ion-temperature-gradient-driven instabilities and turbulence has been extended to investigate the influence of higher radial eigenmodes, sheared toroidal rotation, flat density profiles, and low ion collisionality regimes. Predictions of the theory, which includes both analysis and numerical simulation, for present and future-generation tokamaks are discussed. DOE

N89-15719# Texas Univ., Austin. Inst. for Fusion Studies.
DIFFUSIVE PROCESSES IN THE CROSS-FIELD FLOW OF INTENSE PLASMA BEAMS
B. Newberger and N. Rostoker Sep. 1988 19 p Prepared in cooperation with California Univ., Irvine
(Contract DE-FG05-80ET-53088)
(DE89-001454; DOE/ET-53088/343; IFSR-343) Avail: NTIS HC A03/MF A01

We consider magnetic field diffusion in the presence of strongly magnetized electrons (omega sub ce tau sub co greater than 1) as a mechanism for the rapid field penetration observed in cross-field flows of high-beta plasma beams. The diffusion has been investigated in several cases amenable to analytic solution. The flux penetration times are found to be insensitive to the particular configuration. Comparison with two experiments is made. Agreement within the limits of the experiments is found. Both require an anomalous collision rate consistent with observed fluctuations in one case but apparently not the other. DOE

N89-15720# Los Alamos National Lab., NM.
EXPERIMENTAL SIGNATURES OF LOCALIZATION IN LANGMUIR WAVE TURBULENCE
Harvey A. Rose, D. F. DuBois, David Russell, and B. Bezzerides 1988 43 p Presented at the Conference on Physics of Wave Collapses, Novosibirsk, USSR, 1 Mar. 1988
(Contract W-7405-eng-36)
(DE89-000372; LA-UR-88-2962; CONF-8803153-1) Avail: NTIS HC A03/MF A01

Features in certain laser-plasma and ionospheric experiments are identified with the basic properties of Langmuir wave turbulence. Also, a model of caviton nucleation is presented which leads to certain novel scaling predictions. DOE

N89-15721# Lawrence Livermore National Lab., CA.
A NON-INDUCTIVELY DRIVEN STEADY STATE TOKAMAK REACTOR
M. E. Fenstermacher, R. S. Devoto, R. H. Bulmer, J. D. Lee, J. R. Miller, and J. Schultz (Massachusetts Inst. of Tech., Cambridge.) 20 Sep. 1988 7 p Presented at the 8th Topical Meeting on Technology of Fusion Energy, Salt Lake City, UT, 9 Oct. 1988
(Contract W-7405-eng-48)
(DE89-001243; UCRL-98670; CONF-881031-20) Avail: NTIS HC A02/MF A01

The physics and engineering guidelines for the ITER device are shown to lead to viable and attractive operating points for a steady state tokamak power reactor. Non-inductive current drive is provided in steady state by high energy neutral beam injection in the plasma core, lower hybrid slow waves in the outer regions of the plasma and bootstrap current. Plasma gain Q (equivalent to fusion power/input power) in excess of 20 and average neutron wall loading are predicted in a device with major radius and minor radius. DOE

N89-15722# Lawrence Livermore National Lab., CA.
CURRENT DRIVE BY INTENSE MICROWAVE PULSES
R. H. Cohen, B. I. Cohen, W. M. Nevins, T. D. Rognlien, P. T. Bonoli, and M. Porkolab (Massachusetts Inst. of Tech., Cambridge.) 14 Sep. 1988 15 p Presented at the International

Workshop on Nonlinear Phenomena in Vlasov Plasmas, Cargese, France, 11 Jul. 1988
(Contract W-7405-eng-48)
(DE89-001287; UCID-99583; CONF-880735-1) Avail: NTIS HC A03/MF A01

The advent of high-peak-power pulsed microwave sources opens possibilities for novel current-drive schemes in tokamaks. Four such schemes are considered: accelerating phase-space buckets, overlap of relativistic electron-cyclotron harmonics, beat-wave generation and burnthrough of intense lower-hybrid waves. These schemes are found to offer one or more of the following advantages over their continuous-power counterparts: improved efficiency, improved access to the core plasma, and precise control of the deposition profile. DOE

N89-15723# Lawrence Livermore National Lab., CA.
INERTIAL FUSION RESULTS FROM NOVA AND IMPLICATION FOR THE FUTURE OF ICF
J. D. Kilkenny, M. D. Cable, E. M. Campbell, L. W. Coleman, D. L. Correll, R. P. Drake, R. J. Ellis, S. G. Glendinning, C. W. Hatcher, and S. P. Hatchett et al Oct. 1988 22 p Presented at the 12th International Conference on Plasma Physics and Controlled Nuclear Fusion Research, Nice, France, 12 Oct. 1988
(Contract W-7405-eng-48)
(DE89-001297; UCRL-98540; IAEA-CN-50/B-1-3; CONF-881015-20) Avail: NTIS HC A03/MF A01

A key objective of the U.S. Inertial Confinement Fusion Program is to obtain high yield (100 to 1000 MJ) implosions in a laboratory environment. This requires high gain from an inertial fusion target from a driver capable of delivering about 10 MJ. Recent results have been sufficiently encouraging that the U.S. Department of Energy is planning for such a capability called the Laboratory Microfusion Facility (LMF). In the past two years, we have conducted implosion-related experiments with approximately 20 kJ of 0.35-micron laser light in 1-ns temporally flat-topped pulses. These experiments were done with the Nova laser, the primary U.S. facility devoted to radiatively driven inertial confinement fusion. Our results show that we can accurately model a significant fraction of the phenomena required to obtain the fuel conditions needed for high gain. Both the X-ray conversion efficiency and the growth of Rayleigh-Taylor hydrodynamic instabilities are shown to be at acceptable levels. Targets designed so that the shape of the stagnated fuel can be imaged show that the X-ray drive in our hohlraums can be made isotropic to better than 3 percent. With this optimized drive and temporally unshaped laser pulses many critical implosion parameters are measured on targets designed for higher density. Good agreement is obtained with one-dimensional simulations. Maximum compressions of between 20 to 30 in radius are measured with a variety of diagnostics. Improvements in the driver technology are demonstrated; we anticipate operation of Nova at the 50-kJ level at 3 microns. DOE

N89-15724*# Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
FOR RESEARCH ON WAVES IN PLASMAS Final Report
Donald A. Gurnett Jan. 1989 43 p
(Grant NGL-16-001-043)
(NASA-CR-181358; NAS 1.26:181358) Avail: NTIS HC A03/MF A01 CSCL 20I

A brief overview of the project, especially its funding history, is given. A bibliography of the 397 research papers supported completely or in part by this grant is given. R.J.F.

N89-15725# Lawrence Livermore National Lab., CA.
PLASMA HEATING AND CURRENT DRIVE USING INTENSE, PULSED MICROWAVES
B. I. Cohen, R. H. Cohen, W. M. Nevins, T. D. Rognlien, P. T. Bonoli, and M. Porkolab 1988 21 p Presented at the Joint Varenna-Lausanne Workshop on Theory of Fusion Plasmas, Chexbres, Switzerland, 3-7 Oct. 1988 Prepared in cooperation with Massachesetts Inst. of Tech., Cambridge
(Contract W-7405-eng-48)
(DE89-001127; UCRL-99670; CONF-881124-1) Avail: NTIS HC A03/MF A01

The use of powerful new microwave sources, e.g., free-electron lasers and relativistic gyrotrons, provide unique opportunities for novel heating and current-drive schemes in the electron-cyclotron and lower-hybrid ranges of frequencies. These high-power, pulsed sources have a number of technical advantages over conventional, low-intensity sources; and their use can lead to improved current-drive efficiencies and better penetration into a reactor-grade plasma in specific cases. The Microwave Tokamak Experiment at Lawrence Livermore National Laboratory will provide a test for some of these new heating and current-drive schemes. This paper reports theoretical progress both in modeling absorption and current drive for intense pulses and in analyzing some of the possible complications that may arise, e.g., parametric instabilities and nonlinear self-focusing. DOE

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N89-15726 Stanford Univ., CA.
A PRECISE DETERMINATION OF THE MASS OF A COOPER PAIR OF ELECTRONS IN SUPERCONDUCTING NIOBIUM Ph.D. Thesis
Janet Tate 1988 169 p
Avail: Univ. Microfilms Order No. DA8808428

A superconducting, thin-film niobium ring deposited on the equator of a precision quartz hemispherical rotor was used to measure the ratio of Planck's constant to the mass of a cooper pair of electrons, h/m*. A precision was attained of 5 ppm (statistical) and an accuracy of 30 ppm (systematic) for a combined, root sum of squares error of 30 ppm. As a result of two macroscopic quantum phenomena-flux quantization and the London moment, the flux through a rotating superconducting ring is a multivalued function of its rotation frequency. The flux goes to zero at certain equally spaced frequencies. The ratio h/m* is proportional to this frequency spacing. It is also proportional to the cross sectional area of the niobium ring. The frequency spacing is measured by spinning the quartz hemisphere in a precision helium gas bearing at 6 K, and using a SQUID magnetometer to monitor the flux through the niobium ring as a function of rotation rate. The area of the ring is obtained by measuring two perpendicular equatorial diameters of the quartz rotor at 6 K. This measurement is interferometric, using a continuously tunable dye laser whose frequency is referred to precisely calibrated, Doppler-free absorption lines in molecular tellurium and iodine. The roundness of the quartz rotor is determined at room temperature. Dissert. Abstr.

N89-15727 Bradford Univ. (England).
GROWTH AND CHARACTERISATION OF THIN FILMS OF ZINC SULPHIDE ON SILICON: A COMPARATIVE STUDY OF THE ELECTRICAL AND STRUCTURAL PROPERTIES OF FILMS PREPARED IN ULTRA HIGH VACUUM CONDITIONS BY EVAPORATION AND SPUTTERING, WITH PARTICULAR REFERENCE TO THE ZnS-Si INTERFACE Ph.D. Thesis
David Sands 1987 214 p
Avail: Univ. Microfilms Order No. BRDX81461

Thin films of zinc sulphide were deposited onto p-silicon substrates to form metal-insulator-semiconductor diodes. Using capacitance-voltage, conductance-voltage, and conductance-frequency measurements the properties of the ZnS/p-Si interface were examined. The conclusions support a model of film growth developed in the 1970's, i.e., that an initial reaction between the Si substrate and sulphur is essential to growth. Consequently there is an excess of sulphur at the interface which diffuses into the Si during annealing. Of primary interest were films both sputtered and evaporated in ultra high vacuum, though

magnetron sputtered films were also examined. In addition to the above it was found that sputtering causes considerable damage to the substrate, which results in a very high density of states near mid-gap at the interface. Hence the silicon surface is inverted in thermodynamic equilibrium and the Fermi level well and truly pinned. It is argued that this is potentially useful for electroluminescent devices which require that the inversion condition be reached. However, the films examined here are far too resistive for practical devices and possible ways of increasing the conductivity are discussed. Dissert. Abstr.

N89-15728 New South Wales Univ., Kensington (Australia).
NEW TECHNIQUES FOR THE INVESTIGATION OF GaAs AND OTHER SEMICONDUCTORS USED IN FIELD EFFECT TRANSISTORS Ph.D. Thesis
Z. S. Kachwalla 1988 3 p
Avail: Issuing Activity

Hall effect transient spectroscopy (HETS) was used for the measurement of the transient change in the Hall voltage following the excitation of carriers by light or a voltage pulse applied to a Schottky diode. HETS supplies similar information to the well-known DLTS technique but is easier to implement because it does not require the measurement of capacitance and because only ohmic contacts need to be made to the sample. Three deep-level traps associated with vapor phase epitaxy growth process, previously identified by other authors, were observed using this approach. Spin-dependent resonance (SDR) is a little-used technique which provides an EPR-like spectrum from just the electrically active paramagnetic defects in a sample or device. The SDR technique was extended by the use of double modulation and a theory which gives excellent agreement with experiment was developed. The final method investigated was the frequency dependence of the transconductance of FETs. For the first time it was shown that information about traps, both in the conducting channel as well as those due to surface and interface states, can be extracted from the measurements using only well-known properties of the FET. Author

N89-15729*# Pretoria Univ. (South Africa). Dept. of Physics.
CALCULATIONS OF CRITICAL MISFIT AND THICKNESS: AN OVERVIEW
Jan H. vanderMerwe and W. A. Jesser [1988] 93 p
(Grant NAG1-350)
(NASA-CR-182995; NAS 1.26:182995) Avail: NTIS HC A05/MF A01 CSCL 20L

This overview stresses the equilibrium/nonequilibrium nature of the physical properties, as well as the basic properties of the models, used to calculate critical misfit and critical thickness in epitaxy. Author

N89-15730# Sandia National Labs., Albuquerque, NM.
LIQUID CRYSTALS FOR SURFACE SHEAR STRESS VISUALIZATION ON WIND TURBINE AIRFOILS
D. C. Reda, R. W. Smith, T. C. Bryant, and L. L. Schluter 1988 11 p Presented at the 18th National Conference of the American Wind Energy Association, Honolulu, HI, 19 Sep. 1988
(Contract DE-AC04-76DP-00789)
(DE88-017117; SAND-88-0541C; CONF-880916-1) Avail: NTIS HC A03/MF A01

Experiments were conducted on the Sandia 17-m vertical axis wind turbine to test the liquid-crystal/surface-shear-stress visualization technique in field environments. A Sandia natural-laminar-flow airfoil served as the test surface. Initial feasibility experiments were conducted under high-tip-speed-ratio, high-Reynolds-number conditions, which resulted in low angle-of-attack, quasi-steady flow fields. Data acquisition was accomplished with a tower-mounted movie camera and 35 mm color film. Liquid crystal coatings sensitive only to surface shear stress, and insensitive to temperature changes for temperatures below 50 C, were utilized. Observations of coating color changes showed the liquid crystal technique capable of visualizing surface shear stress distributions, including (by contrast) regions of separated flow, under field-test conditions. DOE

N89-15731*# Catholic Univ. of America, Washington, DC.
LINEAR RESPONSE THEORY FOR ANNEALING OF RADIATION DAMAGE IN SEMICONDUCTOR DEVICES Summary Report
Vitaly Litovchenko 13 Dec. 1988 19 p
(Grant NAG5-864)
(NASA-CR-184584; NAS 1.26:184584) Avail: NTIS HC A03/MF A01 CSCL 20L

A theoretical study of the radiation/annealing response of MOS ICs is described. Although many experiments have been performed in this field, no comprehensive theory dealing with radiation/annealing response has been proposed. Many attempts have been made to apply linear response theory, but no theoretical foundation has been presented. The linear response theory outlined here is capable of describing a broad area of radiation/annealing response phenomena in MOS ICs, in particular, both simultaneous irradiation and annealing, as well as short- and long-term annealing, including the case when annealing is nearing completion. For the first time, a simple procedure is devised to determine the response function from experimental radiation/annealing data. In addition, this procedure enables us to study the effect of variable temperature and dose rate, effects which are of interest in spaceflight. In the past, the shift in threshold potential due to radiation/annealing has usually been assumed to depend on one variable: the time lapse between an impulse dose and the time of observation. While such a suggestion of uniformity in time is certainly true for a broad range of radiation annealing phenomena, it may not hold for some ranges of the variables of interest (temperature, dose rate, etc.). A response function is projected which is dependent on two variables: the time of observation and the time of the impulse dose. This dependence on two variables allows us to extend the theory to the treatment of a variable dose rate. Finally, the linear theory is generalized to the case in which the response is nonlinear with impulse dose, but is proportional to some impulse function of dose. A method to determine both the impulse and response functions is presented. Author

N89-15732# Massachusetts Inst. of Tech., Cambridge. Ceramics Processing Research Lab.
SYNTHESIS AND PROCESSING OF CERAMIC SUPERCONDUCTORS Final Report, 1 Jul. 1987 - 1 Jul. 1988
Michael J. Cima, Wendell E. Rhine, and H. Kent Bowen Jul. 1988 43 p
(Contract N00014-87-K-0736)
(AD-A197889) Avail: NTIS HC A03/MF A01 CSCL 20C

Included are these topics: Synthesis and Processing of Ceramic Superconductors, Powder Processing for Microstructural Control in Ceramic Superconductors, Ba2yCu3O6.9 Powder Preparation by Sol-Gel Emulsion Techniques, Magnetic Inducement of Texture in Ba2YCu3O6.9 Particle Assemblies Under Cryogenic Conditions, Reaction of Ba2YCu3O6.9 Films with Yttria-Stabilized Zirconia Substrates, Synthesis of Ba2YCu3O6.9 Powder. GRA

N89-15733# Brown Univ., Providence, RI. Dept. of Chemistry.
PREPARATION AND CHARACTERIZATION OF Cd(SUB 1 - x)Fe(SUB x)Se SINGLE CRYSTRALS
Kyle Smith, Julio Marsella, R. Kershaw, K. Dwight, and A. Wold 25 Jul. 1988 8 p
(Contract N00014-86-K-0234)
(AD-A197890; TR-16) Avail: NTIS HC A02/MF A01 CSCL 20B

The limit of substitution of iron for cadmium in CdSe was determined by X-ray diffraction of polycrystalline samples to be 11.5 + or - 1 mole percent. Single crystals of Ce1-xFexSe were grown by CVT and by a modified Bridgman method. The magnetic susceptibility of crystals grown by both methods displayed field-independent behavior. Measurements of susceptibility as a function of temperature showed Curie-Weiss behavior with net antiferromagnetic interactions. Bridgman-grown crystals have room temperature resistivities at least 10 to the 3rd power ohm-cm higher than that of the CVT grown crystals (1700 ohm-cm). The

iron concentration of Bridgman-grown crystals was homogeneous in a radial direction, but showed 0.5 - 0.8 mole percent change in iron concentration along the length of the boule. GRA

N89-15734# Rockwell International Corp., Thousand Oaks, CA. Science Center.
RESEARCH ON SPUTTERING OF FERROELECTRIC THIN FILMS Annual Technical Report, 1 May 1987 - 30 Apr. 1988
R. R. Neurgaonkar Jun. 1988 62 p
(Contract F49620-86-C-0052)
(AD-A197899; SC5458.ATR; AFOSR-88-0689TR) Avail: NTIS HC A04/MF A01 CSCL 07B

The magnetron sputtering technique has been used to grow ferroelectric thin films of tungsten bronze (T.B.) PBN:60 and SBN:75, and perovskite PLZT. Film crystallinity was found to be strongly influenced by substrate temperature, with temperatures of 500 to 600 C usually required. Polycrystalline films were grown on quartz, sapphire and glass substrates, whereas oriented crystalline films of PBN:60 and SBN:75 were achieved with SBN:60 substrates, which have a close lattice match. The PLZT films grown on SBN:60 substrates are grain-oriented along the (100)-orientation and have excellent surface texture. This is the first time such films have been grown on T.B. substrates. GRA

N89-15735# Technische Univ., Hanover (Germany, F.R.). Inst. fuer Festkoerperphysik.
CORRELATION OF ATOMIC ROUGHNESS AND ELECTRONIC PROPERTIES AT THE SI/SIO2-INTERFACE Final Technical Report, Apr. 1985 - May 1988
M. Henzler Jun. 1988 33 p
(Contract DAJA45-85-C-0017)
(AD-A198468) Avail: NTIS HC A03/MF A01 CSCL 07B

An investigation of steps and other defects at the Si/SiO sub 2 interface by spot profile analysis of low energy electron diffraction (LEED), and the development of improved defect analysis by use of high resolution LEED systems are discussed. Search for correlations of defects with electronic properties of MOS-devices by measurement of defects and electrical properties on the same wafers was undertaken. The development of the evaluation procedure makes use of a high precision measurement at many different energies. GRA

N89-15736# California Univ., Los Angeles. Dept. of Chemistry and Biochemistry.
GROWTH AND LUMINESCENCE SPECTROSCOPY OF A CuCl QUANTUM WELL STRUCTURE Technical Report No. 7, Aug. 1987 - Jul. 1988
R. S. Williams, D. K. Shuh, and Y. Segawa Jul. 1988 16 p
Prepared in cooperation with Inst. of Physical and Chemical Research, Wako, Japan
(Contract N00014-87-K-0014)
(AD-A198609) Avail: NTIS HC A03/MF A01 CSCL 07B

A structure of the type CaFa2/CuCl/CaF2, in which the confined layer is 150A thick, has been grown on a Si(111) surface by molecular beam epitaxy in ultra high vacuum. The optical properties of the CuCl film have been characterized by low-temperature photoluminescence as a function of excitation density. Striking differences in the excitonic emissions are observed between the quantum well structure and a bulk single crystal of CuCl, and are discussed in terms of purity and thickness. GRA

N89-15737# California Univ., Los Angeles. Dept. of Chemistry and Biochemistry.
INTERFACIAL CHEMICAL REACTIONS OF Au WITH 3-5 COMPOUND SEMICONDUCTORS Technical Report No. 8, Aug. 1987 - Jul. 1988
C. T. Tsai, J. H. Pugh, and R. S. Williams 22 Jul. 1988 23 p
Submitted for publication
(Contract N00014-84-K-0014)
(AD-A198610) Avail: NTIS HC A03/MF A01 CSCL 07D

In order to understand the chemistry at the interface between two solids, one must first know the thermodynamic stability of the bulk materials with respect to each other. When the system involves three elements, such as a gold thin film on a 3-5 compound-semiconductor substrate, a ternary phase diagram must be determined. The solidus portions of the nine Gold-3-5 (3 = Aluminum, Gallium, Indium; 5 = Phosphorus, Arsenic, Antimony) ternary phase diagrams at 298K have been determined. Many of the solid-phase equilibria were found by calculating reaction enthalpies directly from thermochemical data available in the literature. However, for some systems, no data were available, and the required data were estimated or experiments were performed to determine the tie lines through the ternaries. Ideal conditions (no vapor-phase formation or significant mutual solid solubility) were assumed. The resulting phase diagrams may be used to determine, in systems that are effectively closed, which metal/semiconductor interfaces in the Au-3-5 family are stable and which are not. GRA

N89-15738# Lund Univ. (Sweden). Dept. of Solid State Physics.
DEFECTS IN HIGH-MOBILITY SEMICONDUCTOR SYSTEMS AND OTHER LOW-DIMENSIONAL HETEROSTRUCTURES Final Technical Report, 23 Apr. 1987 - 23 Apr. 1988
G. G. Grimmeiss 12 May 1988 58 p
(Contract DAJA45-87-C-0052; DA Proj. 1L1-61103-BH-57)
(AD-A198614; R/D-5916-PH-01-F) Avail: NTIS HC A04/MF A01 CSCL 20L

Experimental work funded under the subject contract was completed at the University of Lund during the period 23 Dec. 1987 to 23 April 1988. The observed findings have now been assessed and interpreted, and the results are presented here in 3 parts. Part 1 describes research on the Pb center of oxidized silicon surfaces. This center provided an important test defect for inauguration of a new opto-electronic measurement system which was assembled at Fort Monmouth as part of the planned research. The Pb center is the most important defect in MOS integrated circuit technology. In addition to being of much interest in itself, it provides an excellent probe to test interface interactions with current carrier holes and elections, and with overlying layers of other semiconductors or superconductors. The optical absorption thresholds of this center were determined by the initial slope method, and compared with electrical energies to yield the Franck-Condon configurational change--found to be in good accord with molecular orbital theory. The parameters measured here will be of direct application in study of high-Tc superconductor interactions with silicon substrates. Part 2 describes similar measurements on defects in GaAs. Defects in this compound semiconductor are much more difficult to characterize, primarily because the best technology--electron spinn resonance--is not so widely applicable as in Si; thus the electrical data cannot be clearly associated with specific point defect structures. Part 3 presents initial work in ESR studies of high T sub c superconductors. GRA

N89-15739# State Univ. of New York, Buffalo. Dept. of Chemistry.
CRITICAL NUCLEATION FIELD AT THE STRUCTURED SURFACE OF A SUPERCONDUCTOR
Z. C. Wu, Daniel A. Jelski, and Thomas F. George Aug. 1988 24 p Submitted for publication
(Contract N00014-86-K-0043)
(AD-A198635; UBUFFALO/DC/88/TR-80) Avail: NTIS HC A03/MF A01 CSCL 20L

The effect of the structured surface of a superconductor on the critical nucleation field is discussed in two cases: one with the magnetic field parallel to the grating wavenumber and the other parallel to the ripples. In the first case, it is found that the critical field is reduced as a function of grating height, whereas in the latter case it is increased. GRA

N89-15740# Naval Postgraduate School, Monterey, CA.
EFFECTS OF NEUTRON IRRADIATION ON HIGH TEMPERATURE SUPERCONDUCTORS M.S. Thesis
John J. Hammerer, Jr. Jun. 1988 60 p
(AD-A199966) Avail: NTIS HC A04/MF A01 CSCL 18G

Neutron irradiation of high temperature superconductors was performed in order to determine the effects of nuclear weapons on these novel materials. This radiation could also be encountered in space radiation belts, fusion reactors and particle accelerators. Fluences used were on the order of 10 to the 18th power fast and thermal neutrons/sq cm. The result of the irradiation was a complete loss of observed superconductivity in YBa2Cu3O7 and ErBa2Cu3O7. A combination of gamma heating of 5 W/g and fast neutron flux imposed serve thermal stress on sample pellets. In two cases, the pellets were reduced to powder. Samples were prepared at the Naval Research Laboratory and the National Research Laboratory and the National Bureau of Standards. They were checked for the Meissner effect using magnetic levitation. The dc four terminal method was used to determine the transition temperature. GRA

N89-15741# Naval Weapons Center, China Lake, CA.
THE 31P SOLID STATE NMR STUDIES OF ZrP, Mg3P2, AND CdPS3
R. A. Nissan and T. A. Vanderah 1988 35 p
(AD-A199981) Avail: NTIS HC A03/MF A01 CSCL 07B

The 31P solid state NMR spectra of ZrP, Mg3P2, MgP4, and CdPS3 are reported. Static and magic angle spinning (MAS) spectra were obtained for each compound. In all cases, chemical shift anisotropy and the effects of dipolar broadening were sufficiently reduced by the MAS method to reveal the isotropic chemical shifts for each crystallographically distinct phosphorus. The observed resonances were assigned to the different types of phosphorus by considering the structural details of each compound. In ZrP the two chemical shifts of +128.4 and +187.5 ppm (relative to 85 percent H3PO4) were assigned to P occupying the Wyckoff 2d and 2a sites, respectively. In Mg3P2, two resonances from the 24d and 8a site P atoms were observed at -262.3 and -239.6 ppm, respectively. In MgP4 two types of phosphorus, one type coordinated to two Mg and two P and the other to three P and one Mg, gave chemical shifts of -109.2 and -6.1 ppm, respectively. From CdPS3 only one resonance at +104.9 ppm is observed as all P atoms are crystallographically equivalent. GRA

N89-15742# Florida Univ., Gainesville. Dept. of Chemical Engineering.
A COMPARATIVE ANALYSIS OF CHEMICAL VAPOR DEPOSITION TECHNIQUES FOR THE GROWTH OF 3-5 EPITAXIAL FILMS Final Technical Report, Apr. 1982 - Jul. 1985
Timothy J. Anderson and Kenneth P. Quinlan Apr. 1988 260 p
(Contract F19628-82-K-0008)
(AD-A200029; RADC-TR-88-31) Avail: NTIS HC A12/MF A01 CSCL 07B

A program to compare the chloride, hydride and metal organic chemical vapor deposition techniques is described. A deposition system capable of depositing films by all three techniques was constructed and equipped with a modulated molecular beam mass spectrometer and, more recently, a Raman spectrometer. The thermal decomposition kinetics of NH3, PH3 and AsH3 were measured and the results applied to reactor operation. The hydride source region was analyzed and design procedure established. The unintentional incorporation of Si in GaAs and InP with the MOCVD process was investigated and methods of reducing these levels suggested. Substrates preparation procedures were compared using UHV surface analysis tools. A significant amount of hydrogen was found in GaAs (100) substrates. GRA

N89-15743# California Univ., Santa Barbara. Dept. of Chemistry.
PHOTOGENERATION OF SELF-LOCALIZED POLARONS IN YBa2 Cu3O7-DELTA AND La2CuO4
Y. H. Kim, C. M. Foster, A. J. Heeger, S. Cox, and L. Acedo Aug. 1988 16 p Previously announced in IAA as A89-16917
(Contract N00014-87-K-0457)
(AD-A199209; TR-25) Avail: NTIS HC A03/MF A01 CSCL 07B

Photoinduced infrared absorption measurements of YBa2Cu3O7-delta (delta=0.75) and La2CuO4 are reported. We have observed photoinduced infrared active vibrational modes and associated phonon bleachings which indicate the formation of a localized structural distortion in the Cu-O plane around the photogenerated carriers. In both materials, an associated electronic transition indicates that this structural distortion causes the formation of a self-localized electronic state in the energy gap. The photoinduced distortion and the associated self-localized gap state demonstrate that the photoexcitations are relatively long-lived polarons (or bipolarons). The dynamic mass associated with the distortion is smaller in YBa2Cu3O7-delta than in La2CuO4 (smaller dynamic mass implies a longer range distortion). Since these features are not observed in the isostructural compound, La2NiO4, we suggest that polaron (or bipolaron) formation may play an important role in the high temperature superconductivity. GRA

N89-15744# North Carolina State Univ., Raleigh. Dept. of Materials Science and Engineering.
GROWTH, CHARACTERIZATION AND DEVICE DEVELOPMENT IN MONOCRYSTALLINE DIAMOND FILMS Annual Report, 1 Jun. 1987 - 31 May 1988
R. F. Davis, J. T. Glass, G. Lucovsky, K. J. Bachmann, and R. J. Nemanich 1 Jun. 1988 109 p
(Contract N00014-86-K-0666)
(AD-A199321) Avail: NTIS HC A06/MF A01 CSCL 20B

Cu single crystals have been grown and prepared for use as a lattice matched substrate. A literature survey of potential substrates which are both lattice and energy matched with diamond to promote two-dimensional growth has also been completed and promising materials are currently being utilized for diamond growth. Two chemical vapor deposition systems have been designed. The first, a hot filament system, has been constructed, characterized and used to deposit diamond on a variety of substrates. A microwave chemical vapor deposition system and an in-situ analysis system are currently under construction. Films have been analyzed by numerous techniques, the most significant being Raman spectroscopy and the first reported high resolution lattice imaging of CVD diamond. Diamond power MESFET devices have been theoretically evaluated and found to be capable of generating rf power output levels greater than other existing or proposed semiconductors, including Gallium Arsenide. Efficiency for the diamond MESFETs greater than 40 percent was determined and a more linear response and greater dynamic range than GaAs was found. GRA

N89-15745# California Univ., Santa Barbara. Dept. of Chemistry.
THE STRUCTURE AND OPTICAL PROPERTIES OF CdS SUPERCLUSTERS IN ZEALITE HOSTS
Norman Herron, Ying Wang, Mike Eddy, Galen D. Stucky, and Dave Cox May 1988 69 p
(Contract N00014-87-K-0457)
(AD-A199402; TR-4) Avail: NTIS HC A04/MF A01 CSCL 07B

Direct synthesis of Cadmium Sulfide within the pore structure of zeolites leads to a novel supercluster with a structural geometry superimposed by the host framework. Detailed X-ray powder diffraction, EXAFS analysis and optical absorption data reveal discrete (CdS)4 cubes located within the small sodalite units of the structure which begin to interconnect as the loading density within the zeolite rises. The discrete cube building blocks consist of interlocking tetrahedra of Cd and S with a CdS bond length of 2.47A. At higher loadings these cubes begin to occupy adjacent sodalite units where the Cd atoms point toward each other through the double six-rings linking the sodalite moeities with a Cd-Cd distance of approx. 6A. As this three dimensional interconnection proceeds, the corresponding changes in optical properties indicate a transformation to a semiconductor supercluster with behavior intermediate between that of the discrete CdS cubes and bulk semiconductor. Semiconductor superclusters represent a novel class of materials where the 3-dimensional structure and electronic properties can be controlled by using different zeolites as the template. GRA

N89-15746# Westinghouse Research and Development Center, Pittsburgh, PA.
RESEARCH ON SEMICONDUCTORS AT CRYOGENIC TEMPERATURES Final Report, 1 Jul. 1985 - 18 Jun. 1988
G. R. Wagner and M. A. Janocko 26 Jun. 1988 40 p
(Contract N00014-85-C-0579)
(AD-A199505) Avail: NTIS HC A03/MF A01 CSCL 07B

The Hall mobility and magnetoresistance of selectively doped heterostructures of Si(sub x)Ge(sub x-i)/Ge prepared by molecular beam epitaxy (MBE) have been studied in the temperature range 1.5 less than T less than 300K. Either Al or B was used to dope the alloy p-type. Evidence was found in the B-doped samples with x = 0.5 that a 2DHG is formed in the Ge at the heterointerface. The mobility at T = 4.2K in a sample with an undoped alloy spacer layer of 4 nm was mu subH = 3200 sq cm/ V-sec and in other samples was found to decrease with spacer layer thickness. Shubnikov-de Haas oscillations were observed at T = 1.5K with the magnetic field normal to the interface, but not with the field parallel to it. The oscillation period yields a surface charge density of 2 x 10 to the 12th/sq cm in reasonable agreement with the value of 3 x 10 to the 12th/sq cm obtained by Hall measurements. GRA

N89-15747# Sandia National Labs., Albuquerque, NM.
INVESTIGATIONS OF SUPERCONDUCTING AND NON-SUPERCONDUCTING YBa2Cu3O(SUB 7-x) BY FIELD ION MICROSCOPY, ATOM-PROBE SPECTROSCOPY AND FIELD ELECTRON EMISSION
G. L. Kellogg and S. S. Brenner 1988 7 p Presented at the 35th International Field Emission Symposium, Oak Ridge, TN, 18 Jul. 1988
(Contract DE-AC04-76DP-00789)
(DE88-014972; SAND-88-1930C; CONF-880791-2) Avail: NTIS HC A02/MF A01

The structure and composition of superconducting and non-superconducting samples of the YBa2Cu3O(sub 7-x) were examined by field ion microscopy, atom-probe mass spectroscopy and field-electron emission techniques. Field ion microscope images from both types of material exhibited ring structures associated with atomic or multiatomic layers and uniform, layer-by-layer field evaporation was possible. Atom-probe mass spectra contained signals corresponding to atomic and molecular oxygen, all three metals, and oxides of Cu and Y. Atom-probe mass spectra from the superconducting samples (x approximately 0.35) contained a much larger molecular oxygen signal than mass spectra from the non-superconducting samples (x approximately 0.8) indicating that oxygen in the CuO chains is field desorbed preferentially as molecular oxygen ions. Field electron emission from the superconducting samples exhibited normal Fowler–Nordheim characteristics above and below the superconducting transition temperature. Surface contaminates were found to decrease the work function of the material by as much as 39 percent. With the exception of one isolated experiment, no significant temperature effect on the field emission characteristics were observed. DOE

N89-15748# Los Alamos National Lab., NM.
SURFACE ELECTRONIC BEHAVIOR OF ACTINIDE MATERIALS
You Gong Hao, Gayanath W. Fernando, and Bernard R. Cooper (West Virginia Univ., Morgantown.) 1988 26 p Presented at the 35th National Vacuum Symposium and 4th International Laser Science Conference, Atlanta, GA, 2 Oct. 1988
(Contract W-7405-eng-36)
(DE89-000354; LA-UR-88-3055; CONF-881002-7) Avail: NTIS HC A03/MF A01

The self-consistent Film Linearized Muffin-Tin (FLMTO) method has been used to calculate the surface electronic structure of plutonium. This has been done using a (111)-oriented five-layer slab geometry. We use the full potential in the interstitial and vacuum, while the Non-Muffin-Tin (NMT) potential in the spheres is approximated by the extended interstitial NMT potential. The calculated work function of plutonium is strongly affected by the treatment of the 6p electrons, and with spin-orbit coupling effects included is 4.3 eV with 6p electrons treated as core, in good agreement with experimental values of 3.4 to 4.3 eV for uranium. A much higher calculated value of 8.4 eV if the 6p electrons are treated as valence electrons, shows that the 6p electrons are largely localized. The narrow band width of the 5f electrons and the position relative to s and d bands relate to the intermediate delocalization of the 5f electrons and the existence of hybridization with the s and d electrons. DOE

N89-15749# Argonne National Lab., IL. Materials Science Div.
FERMI SURFACES IN YBa2Cu3O(SUBx)
L. C. Smedskjaer, J. Z. Liu, R. Benedek, D. G. Legnini, D. J. Lam, H. Claus, and A. Bansil (Northeastern Univ., Boston, MA.) 1988 4 p Presented at the 8th International Conference on Positron Annihilation, Ghent, Belgium, 29 Aug. - 3 Sep. 1988
(Contracts W-31-109-eng-38; DE-FG02-85ER-45223)
(DE89-000532; CONF-8808122-7) Avail: NTIS HC A02/MF A01

We report 2-D ACAR measurements in both c- and a-axis projections on single crystal YBa2Cu3O(x), with oxygen concentrations x is approximately 7 (T sub c = 93.6 K) and x is approximately 6.7 (T sub c = 61 K), and a set of Fermi surfaces is proposed for both compositions. We discuss how Fermi-surface signatures may be distinguished from certain prominent features in the 2-D ACAR data unrelated to the Fermi surfaces. DOE

N89-15750# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Chemical Science Div.
MODULATED STRUCTURE OF SUPERCONDUCTING Bi2CaSr2Cu2O8+DELTA
R. Gronsky, M. Fendorf, K. Fortunati, P. Hor, R. L. Meng, and C. W. Chu (Houston Univ., TX.) May 1988 3 p Presented at the MAS/EMSA Microbeam Analysis Conference, Milwaukee, WI, 7-12 Aug. 1988
(Contract DE-AC03-76SF-00098)
(DE89-000556; LBL-25844; CONF-880841-20) Avail: NTIS HC A02/MF A01

In the continuing search for new oxide superconductors, attention has recently been drawn to the Bi-Sr-Cu-O system. Independent pursuits by the groups in Japan and Houston led to their simultaneous announcements of a new material with consistently high transition temperatures in the 100 K range. This new compound is believed to have nominal composition Bi2CaSr2Cu2O(8+delta) and orthorhombic unit cell dimensions of a = 5.44 A, b = 27.2 A, and c = 30.78 A. Subsequent electron microscopy investigations of the material identified both an incommensurate structure, and a two phase mixture, related structurally to the original Bi2CaSr2Cu2O(8+delta) phase. This investigation seeks further understanding of the microstructure of the new compound by a transmission electron microscopy study of single crystals (T sub c = 85 K) grown at the University of Houston. DOE

N89-15751# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Chemical Science Div.
MORPHOLOGICAL EVOLUTION OF PORE CHANNELS IN ALUMINA
J. Roedel and A. M. Glaeser Aug. 1988 23 p Presented at the Symposium on the Sintering of Advanced Ceramics, Cincinnati, OH, 1-5 May 1988
(Contract DE-AC03-76SF-00098)
(DE89-000559; LBL-25147; CONF-8805164-2) Avail: NTIS HC A03/MF A01

The morphological evolution of pore channels in sapphire bicrystals during annealing at 1800 C has been studied. The effects of boundary crystallography as well as channel orientation within the boundary plane have been examined by using bicrystals with channels etched into either the (0001) or the (11'20) planes, and oriented parallel to the (11'00) and (112'0) directions for the (0001) plane and parallel to the (11'00) and (0001) directions in the (112'0) plane. The critical aspect ratio for breakup into multiple pores, the kinetics of breakup, and the apparent surface diffusivity

are affected by changes in channel crystallography. These behavioral differences are attributed to surface energy anisotropy effects. DOE

N89-15752# Brookhaven National Lab., Upton, NY. Dept. of Applied Science.
HIGH T(SUB c) SUPERCONDUCTORS FROM METALLORGANIC PRECURSORS
Y. L. Wang, W. T. Chou, T. Skotheim, R. Budhani, M. Suenaga, and Y. Okamoto 1988 6 p Presented at the International Conference on Science and Technology of Synthetic Metals, Santa Fe, NM, 26 Jun. 1988
(Contract DE-AC02-76CH-00016)
(DE89-001090; BNL-41737; CONF-880669-21) Avail: NTIS HC A02/MF A01

High T(sub c) cuprate superconductors have been made by pyrolysis of metallorganic precursors (polyacrylic acid and acetates) incorporating the appropriate molar ratios of metal ions to form the desired copper oxide compounds. Two processes have been described as representative examples of novel strategies to produce high T(sub c) superconductors in bulk and thin film form: pyrolysis of metallorganic powders for bulk processing and spray pyrolysis for thin film fabrication. DOE

N89-15753# California Univ., Berkeley. Lawrence Berkeley Lab.
THE HIGH T(SUB c) SUPERCONDUCTING BOLOMETER
P. L. Richards, S. Verghese, T. H. Geballe, and S. R. Spielman Aug. 1988 5 p Presented at the Applied Superconductivity Conference, San Francisco, CA, 21 Aug. 1988
(Contract DE-AC03-76SF-00098)
(DE89-001255; LBL-25812; CONF-880812-15) Avail: NTIS HC A02/MF A01

A description is given of the optimization of a bolometric infrared detector which uses the resistive transition of a high T sub c film as the thermometer. The performance of a LN cooled far infrared bolometer operated with a cooled low-pass filter is computed for the ideal case of a noise-free readout. The theory is then extended to include various contributions to the readout noise. Measurements are presented of the low frequency noise near T sub c in current biased films of ErBa2Cu3O7, which show that useful performance can be achieved. Comparisons are made with other infrared detection technologies which show that practical high T sub c bolometers will be especially useful for wavelengths longer than the approximately 20 micron cutoff of LN cooled photovoltaic detectors. Potential applications include far infrared laboratory spectroscopy and passively cooled space observations of bright sources such as the earth. DOE

N89-15754# Lawrence Livermore National Lab., CA.
RAMAN SCATTERING IN CRYSTALS
David F. Edwards 30 Sep. 1988 49 p
(Contract W-7405-eng-48)
(DE89-001284; UCID-21510) Avail: NTIS HC A03/MF A01

A tutorial presentation is given of Raman scattering in crystals. The physical concepts are emphasized rather than the detailed mathematical formalism. Starting with an introduction to the concepts of phonons and conservation laws, the effects of photon-phonon interactions are presented. This interaction concept is shown for a simple cubic crystal and is extended to a uniaxial crystal. The correlation table method is used for determining the number and symmetry of the Raman active modes. Finally, examples are given to illustrate the relative ease of using this group theoretical method and the predictions are compared with measured Raman spectra. DOE

N89-15755# Brookhaven National Lab., Upton, NY.
PREPARATION AND SOME PROPERTIES OF H(SUB x)REBa2Cu3O7 (RE = Er, Nd, Dy, Ho, Gd) SUPERCONDUCTORS
J. Johnson, M. Suenaga, P. Thompson, and J. Reilly 1988 6 p Presented at the Metal Hydrogen Systems Fundamentals and Applications Conference, Stuttgart, Fed. Republic of Germany, 4 Sep. 1988
(Contract DE-AC02-76CH-00016)
(DE89-002178; BNL-41783; CONF-880969-4) Avail: NTIS HC A02/MF A01

Hydrogen gas has been found to react directly with the subject oxides. Most exhibit a small region of H solid solubility which remains superconducting with a slight increase in critical temperature (1 to 2K). At higher H contents a hydrogen rich hydride phase precipitates which is amorphous. The H rich phases are not superconducting at 4K or above. Neutron diffraction studies of D(sub 1.55)YBa2Cu3O7 confirm that the D rich phase is amorphous but that its precipitation causes increased microtwinning in the D saturated oxide. DOE

N89-15756# California Univ., Berkeley. Lawrence Berkeley Lab. Engineering Div.
HIGH T(SUB c) SUPERCONDUCTORS: WILL THEY REPLACE HELIUM TEMPERATURE SUPERCONDUCTORS FOR MAGNETS
Michael A. Green Jul. 1988 5 p Presented at the ASME Winter Annual Meeting, Chicago, IL, 28 Nov. 1988
(Contract DE-AC03-76SF-00098)
(DE88-016634; LBL-25734; CONF-881120-8) Avail: NTIS HC A02/MF A01

During the last two years, the maximum zero resistance critical temperature for superconductors has risen from 23 K to temperatures above 120 K. This paper presents a sober view of the usefulness of the high T sub c materials for generating magnetic fields in superconducting devices. The high T sub c materials are compared to conventional niobium titanium superconductors in the following areas: critical current density, adiabatic and dynamic stability, normal region propagation velocity, burn out integral, energy per unit volume to quench and the maximum cryogenic stability current density. A look at the whole picture suggests that for most superconducting magnet applications, conventional conductors would be the superconductors of choice for magnets. DOE

N89-15757# Sandia National Labs., Albuquerque, NM.
SIMULTANEOUS MEASUREMENT OF THE CONDUCTION AND VALENCE-BAND MASSES IN STRAINED-LAYER STRUCTURES
E. D. Jones, S. K. Lyo, J. F. Klem, J. E. Schirber, and C. P. Tigges 1988 10 p Presented at the International Symposium on Gallium-Arsenide and Related Compounds, Atlanta, GA, 11 Sep. 1988
(Contract DE-AC04-76DP-00789)
(DE88-017349; SAND-88-1295; CONF-8809152-1) Avail: NTIS HC A02/MF A01

Simultaneous measurement of both the conduction and valence-band masses in strained-layer structures is presented. These measurements rely on application of our recent theoretical predictions regarding breaking of the usual selection rules for interband magneto-luminescence transitions in modulation-doped structures. Thus, from a single sample, the dispersion relations for both the conduction and valence-band can be measured and analyzed. Low-temperature (4K) magneto-luminescence data for a representative GaAs InGaAs AlGaAs (15 percent In, Al) n-type 125 angstrom single-strained-quantum well structure are presented. We measure zone-center conduction and valence-band effective masses of 0.068 and 0.10m, respectively. For increasing band energies (40 MeV above the bandgap energy) the conduction-band is parabolic while the valence-band is highly nonparabolic; the valence-band mass increased to about 0.2 in this energy range. DOE

N89-15758# California Univ., Berkeley. Lawrence Berkeley Lab.
STANDARD-STATE GIBBS ENERGIES OF THE BCC, HCP, AND CCP STRUCTURES OF METALS
L. Brewer Jul. 1988 17 p Presented at the 17th CALPHAD Conference on Computer Coupling of Phase Diagrams and Thermochemistry, Berkeley, CA, 10 Jul. 1988

(Contract DE-AC03-76SF-00098)
(DE89-000563; LBL-25878; CONF-8807119-1) Avail: NTIS HC A03/MF A01

It is common practice to use the stable crystal form of a metal as the standard state for solid solutions and to use the pure liquid as the standard state for liquid solutions. When the deviations from Raoult's Law are small, this is usually the most convenient procedure even when the solid solution has different crystal structure. However, when the deviations are substantial and one is interested in relatively dilute solutions, it is more convenient to use a standard state with the same crystal structure as the solid solution. Thermodynamic data are presented for the pure standard states (Raoult's Law standard states) for stable and metastable structures and for the Henry's Law standard states with the structure of the solid solution. Henry's Law standard states are also given for the liquid. DOE

N89-15759# Argonne National Lab., IL. Materials Science Div.
MICROSTRUCTURAL ANALYSIS OF SUPERCONDUCTING CERAMICS
Donglu Shi and Richard H. Lee 1988 15 p Presented at the Inter/Micro-88 Conference, Chicago, IL, 27 Jun. 1988 Submitted for publication
(Contract W-31-109-eng-38)
(DE89-000613; CONF-8806248-1) Avail: NTIS HC A03/MF A01

Scanning electron and polarized light microscopy were used to analyze the microstructures of high-T(sub c) superconducting materials in the Y-Ba-Cu-O and Bi-Sr-Ca-Cu-O systems. The superconducting properties of Y1Ba2Cu3O(sub 7-x) samples were found to be strongly affected by the microstructural changes that result from different sintering and heat treatments. Second phases, such as BaCuO2 and CuO2, were identified by backscattered electron imaging and energy dispersive X-ray analysis. Polarized light microscopy was used to study the twinned structure and phase transformation of the Y-Ba-Cu-O system. The results of microstructural analysis show a consistent correlation between the superconducting and microstructural properties. The process of tetragonal-to-orthorhombic phase transformation was clearly revealed by polarized light microscopy. Crystallization of rapidly solidified Bi2Sr2Ca2Cu3O(sub x) glass was studied by means of secondary electron imaging. In addition, special techniques were developed for sample preparation. DOE

N89-15760# Lawrence Livermore National Lab., CA.
MODELING INDUCTION HEATING AND 3-D HEAT TRANSFER FOR GROWTH OF RECTANGULAR CRYSTALS USING FIDAP
L. J. Atherton and R. W. Martin 19 Sep. 1988 37 p Presented at the FIDAP Users Conference, Evanston, IL, 2 Oct. 1988
(Contract W-7405-eng-48)
(DE89-001323; UCRL-99629; CONF-8810186-1) Avail: NTIS HC A03

We are developing a process to grow large rectangular crystals for use as solid state lasers by a Bridgman-like method. The process is based on induction heating of two graphite susceptors which transfer energy to an ampoule containing the melt and crystal. The induction heating version of FIDAP developed by Gresho and Derby is applied to this system to determine the power deposition profile in electrically conducting regions. The calculated power is subsequently used as a source term in the heat equation to calculate the temperature profile. Results are presented which examine the sensitivity of the system to electrical and thermal conductivities, and design modifications are illustrated which could improve the temperature field for crystal growth applications. DOE

N89-15761# Lawrence Livermore National Lab., CA. Chemistry and Materials Science Dept.
OBSERVATIONS OF DISLOCATION INTERACTIONS WITH RECRYSTALLIZED GRAIN BOUNDARIES
C. W. Price Aug. 1988 9 p Presented at the MAS/EMSA Microbeam Analysis Conference, Milwaukee, WI, 7 Aug. 1988 Submitted for publication
(Contract W-7405-eng-48)
(DE89-001356; UCRL-99349; CONF-880841-22) Avail: NTIS HC A02/MF A01

Possible evidence of the interaction of individual dislocations with recrystallized grain boundaries (GBs) was found in aluminum specimens that had been statically recrystallized after hot deformation. Matrix dislocations from the deformed material appeared to terminate on the recrystallized GB; however, GB dislocations (GBDs) that should have formed from the absorption of the matrix dislocations were not present. In addition, subboundary structure immediately in front of the moving GB appeared to have undergone accelerated dissociation. These observations suggest that rapid GB motion is not associated with lateral movement of GBDs, and short-range dislocation-GB interaction forces, probably image forces, could cause climb-induced vacancy supersaturations to form in front of the GB. This supersaturated vacancy atmosphere could constitute an important contribution to rapid GB migration. DOE

N89-15762# Sandia National Labs., Albuquerque, NM.
HALL-EFFECT AND PHOTOLUMINESCENCE MICROSCOPY STUDIES OF DISLOCATION FORMATION IN STRAINED-LAYER EPITAXY OF InGaAs/GaAs
I. J. Fritz, P. L. Gourley, and L. R. Dawson 1988 7 p Presented at the International Symposium on Gallium-Arsenide and Related Compounds, Atlanta, GA, 11 Sep. 1988
(Contract DE-AC04-76DP-00789)
(DE89-001373; SAND-88-1437C; CONF-8809152-3) Avail: NTIS HC A02/MF A01

Hall-mobility measurements in modulation-doped strained quantum-well structures are highly sensitive to dislocations, and mobility studies have determined critical layer thicknesses for strained-layer epitaxy in InGaAs/GaAs structures. Recent measurements on quasi-pseudomorphic multiple strained quantum-well structures have shown good electrical properties for structures with nominal strain energy up to approx. 30 times the value expected for dislocation formation. This result has been achieved in 30-period structures with widely spaced (approx. 50nm) layers of In0.2Ga0.8As, each somewhat thinner than the critical layer thickness of approx. 15nm. Photoluminescence microscopy studies on these structures show dislocations only near the deepest interfaces, suggesting that most of the quantum wells are of high quality. DOE

N89-15763# Brookhaven National Lab., Upton, NY. Dept. of Physics.
GROWTH AND ELECTRONIC STRUCTURE OF Nb AND Ta FILMS ON Pd AND THEIR INTERACTION WITH CO
L. Q. Jiang, M. W. Ruckman, and M. Strongin 1988 17 p Presented at the 35th National Vacuum Symposium and 4th International Laser Science Conference, Atlanta, GA, 2 Oct. 1988 Prepared in cooperation with Queens Coll., Flushing, NY
(Contract DE-AC02-76CH-00016)
(DE89-001104; BNL-41761; CONF-881002-11) Avail: NTIS HC A03/MF A01

The growth of Nb and Ta films on Pd(111) and their modification of CO chemisorption are studied using UPS, LEED, and low energy ion scattering (LEIS). At 300K LEIS shows significant amounts of Pd in the top layer even after more than a monolayer of Nb or Ta is deposited. This is in contrast to Pd on Nb or Ta(110) where a Pd monolayer completely covers the substrate. UPS shows that the surface electronic structure at monolayer Nb or Ta coverage resembles that of a Pd monolayer on Nb or Ta(110) and is characterized by strong Pd 4d emission 1 to 4 eV below Ef and a low density of states at Ef. Molecular CO adsorption is observed at submonolayer coverage, there is negligible CO adsorption at monolayer coverage and dissociative CO adsorption starts at greater than monolayer coverage. It is concluded that the deposited Nb and Ta monolayers intermix with the Pd(111) substrate and it is also shown that this behavior can be understood by examining the energies of the system. DOE

N89-15764# Technical Research Centre of Finland, Espoo. Semiconductor Lab.
DIFFUSION BARRIERS IN SEMICONDUCTOR CONTACT METALLIZATION Ph.D. Thesis - Helsinki Univ. of Technology
Hannu Kattelus May 1988 125 p
(VTT-RR-48; ISBN-9-51-383120-5; ISSN-0358-5069; ETN-89-93531) Copyright Avail: NTIS HC A06/MF A01; Technical Research Centre of Finland, Vuorimiehentie 5, SF-02150 Espoo, Finland, 95 Finnish marks

Diffusion barriers are classified in terms of their structure or their relative stability at elevated temperatures. It is pointed out that metallic films are not the most favorable choice for diffusion barriers. It is noted that film structure determines partially the value of the barrier. Multilayer configurations to optimize the overall contact performance are discussed. The experimental part concentrates on properties of tunsten-nitrogen alloys and titanium nitrides for application as diffusion barriers in silicon and gallium arsenide metalization schemes. Nitrogen stabilizes tungsten barriers. In ohmic contacts to gallium arsenide, titanium nitride is shown to enhance thermal stability. ESA

N89-15765*# Eagle Engineering, Inc., Houston, TX.
LUNAR BASE APPLICATIONS OF SUPERCONDUCTIVITY: LUNAR BASE SYSTEMS STUDY TASK 3.4
31 Oct. 1988 56 p
(Contract NAS9-17878)
(NASA-CR-172102; NAS 1.26:172102; EEI-88-218) Avail: NTIS HC A04/MF A01 CSCL 20L

The application of superconductor technology to several key aspects of an advanced-stage Lunar Base is described. Applications in magnetic energy storage, electromagnetic launching, and radiation shielding are discussed. Author

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N89-15766 Universidade Federal do Maranhao, Sao Luis (Brazil). Dept. of Physics.
GRAVITATION ELECTROMAGNETIC THEORY
Fran deAquino Mar. 1988 89 p
Copyright Avail: Issuing Activity

The interrelationship existing between gravitation and electromagnetism is examined. A brief summary of the ideas which have guided scientific thought toward an understanding of gravitation is presented. The development of the electromagnetic theory is presented. The effects of the action of electromagnetic fields on the gravitational interactions are shown. On one side is, the explanation of various important cosmological phenomena, and on the other side, the path to control the gravitational interaction, which will foster the advent of gravitational propulsion, the foundations of which are established. The implications of this theory to the biological field are explored. In this field, the local control of gravitation opens the way to the study of the biological processes under several different conditions of gravity, which, in turn, may bring forth important results in biological research. B.G.

N89-15767# Los Alamos National Lab., NM.
HARD CORE PERTURBATION THEORY
Richard N. Silver 1988 11 p Presented at the 12th International Conference on Condensed Matter Theories, Taxco, Mexico, 14 Aug. 1988 Submitted for publication
(Contract W-7405-eng-36)
(DE89-000384; LA-UR-88-2896; CONF-8808136-1) Avail: NTIS HC A03/MF A01

A novel perturbative expansion of the dynamic susceptibility about the ground state wave function is proposed. The method uses Liouville perturbation expansions, the Hubbard-Stratonovich transformation of the Hamiltonian with fictitious bosons, projection super-operators and super-duper-operators. The method is especially applicable to the dynamical susceptibility of strongly-interacting systems, where ground state correlation functions and density matrices are available from calculations or experiments. To illustrate the method, the final state corrections to the impulse approximation are derived for high momentum transfer neutron scattering. DOE

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

No abstracts in this category.

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N89-15768 Texas Univ., Austin.
A STUDY OF THE INFLUENCE OF TASK COMPLEXITY AND A DECISION SUPPORT AID ON DECISION PROCESSES Ph.D. Thesis
Pai-Cheng Chu 1987 191 p
Avail: Univ. Microfilms Order No. DA8806306

A controlled laboratory experiment was conducted to address the following research questions: (1) Do task complexity and the use of a decision support aid either singularly or jointly influence the decision processes adopted; (2) Does the decision process adopted have an impact on decision quality and decision confidence. The decision processes examined are the incremental approach versus the synoptic approach as defined by Lindblom, Braybrooke, and Hirschman. The results of the experiment are given and briefly discussed. Dissert. Abstr.

N89-15769# Rome Air Development Center, Griffiss AFB, NY.
[TECHNICAL PROGRAMS OF THE ROME AIR DEVELOPMENT CENTER IN SUPPORT OF THE AIR FORCE COMMAND, CONTROL, COMMUNICATIONS AND INTELLIGENCE (C3I) MISSION] Technical Objective Document, fiscal year 1989
Carlo P. Crocetti Dec. 1987 75 p
(AD-A197877; RADC-TR-87-302) Avail: NTIS HC A04/MF A01 CSCL 25E

This Technical Objective Document describes the technical programs of the Rome Air Development Center (RADC) in support of the Air Force Command, Control, Communications, and Intelligence (C3I) mission. The technical objectives have been aligned with the VANGUARD mission areas of Command, Control, and Communications (C3), Reconnaissance and Intelligence, Strategic Systems (Defense) and Technology as a means of focusing the RADC support of VANGUARD. This document is prepared to provide industry and universities with the midterm technical objectives in these areas. RADC plans and executes research, exploratory, and advanced development and selected acquisition programs in support of Air Force C3I and Computational Sciences requirements. The principal technical areas are communications, intelligence and reconnaissance, surveillance, command and control, electromagnetic sciences, and solid state sciences, and electronic reliability, maintainability, and compatibility. GRA

N89-15770*# Houston Univ., TX. Dept. of Industrial Engineering.
AN INVESTIGATION OF TRANSITIONAL MANAGEMENT PROBLEMS FOR THE NSTS AT NASA Quarterly Report, 15 Apr. - 15 Jul. 1988

John Hunsucker 15 Jul. 1988 78 p Sponsored by NASA
(NASA-CR-172094; NAS 1.26:172094) Avail: NTIS HC
A05/MF A01 CSCL 05A

This quarterly report summarizes the ideas and concepts developed by the University of Houston team with the collaboration and support of the Management Integration Offices of NASA. In addition it is hoped that this report will help to stimulate the healthy problem solving process already present at NASA. This is the second report in the fourth year of the research contract. The main aim of the work is to assist the National Space Transportation System (NSTS) in finding ways and means of moving into a truly operational era in the sense of routine timely production of flights. The reader who seeks an understanding of the concepts presented is encouraged to read the reports of the last three years. The overall strategy of this effort is to: (1) search the literature for applications of transition management and other related issues, (2) conduct investigations into the experiences of the industries with the transition management, and (3) to adapt the information found in (1) and (2) above into a form useful to NASA while at the same time applying industrial engineering and engineering management expertise to problems and issues as they emerge.
Author

N89-15771*# Houston Univ., TX. Dept. of Industrial Engineering.
AN INVESTIGATION OF TRANSITIONAL MANAGEMENT PROBLEMS FOR THE NSTS AT NASA, EXECUTIVE SUMMARY
Quarterly Report, 15 Jul. - 15 Oct. 1988
John Hunsucker 15 Oct. 1988 151 p Sponsored by NASA
(NASA-CR-172096; NAS 1.26:172096) Avail: NTIS HC
A08/MF A01 CSCL 05A

A summary is given of the work of the University of Houston research team for the third quarter of effort in a yearly grant for the National Space Transportation System (NSTS). As such it serves as a resting place for the ideas and concepts developed this quarter with the collaboration of the Management Integration Offices of NASA. Another objective is the hope that the report will help to stimulate the healthy problem solving process already present at NASA. The main goal of the contractual work is to help NASA to find ways and means of moving into a truly operational era with the shuttle program. This work is a continuation of early work and the reader is encouraged to read the final reports of earlier years. Chapter One of the report is an introduction. Chapter Two deals with industrial adaptation and is in two parts: theory and application. In the theory section, impressions of the management system immediately after reflight are discussed. A key issue, in the author's opinion is the seeming lack of purpose of the program. The application section has six appendices: 1988 Demographic Survey, Field Notes of Interview with HL/P South Texas Nuclear Project, a comparison of the Agendas of the current manager with that of a previous manager, a note on compartmentalization to assist in manifesting, a study on launch prediction for STS-26, and a discussion of a statistical decision-making course for upper level managers. Chapter Three deals with theoretical results returned on flow shop scheduling which will be of use downstream. Chapter Four deals with a statistical model developed to predict the flight rate in future years and indicates the program will have trouble making its schedule. Chapter Five covers the constructural effort and shows the work to be on schedule.
Author

N89-15772# Colorado Univ., Boulder. Center for Research on Judgment and Policy.
JUDGEMENT AND DECISION MAKING IN DYNAMIC TASKS
Interim Report
Kenneth R. Hammond Aug. 1988 40 p
(Contract MDA903-86-C-0142)
(AD-A199907; ARI-RN-88-81) Avail: NTIS HC A03/MF A01
CSCL 05H

This research note presents a theory of task conditions on the grounds that such a theory is a prerequisite for studying dynamic decision making. The principal features of the theory are: (1) a task-cognition inducement principle, (2) a distinction drawn between surface and depth characteristics of tasks, and (3) a task continuum index. Also presented is a theory of cognition in dynamic tasks, the main features of which are a cognitive continuum index set in parallel with the continuum index, and a description of the role of pattern seeking and functional-relation seeking in dynamic tasks. The practical consequences for both designers and operators are indicated.
GRA

N89-15558*# National Aeronautics and Space Administration, Washington, DC.
DEVELOPMENT OF AN EXPERT PLANNING SYSTEM FOR OSSA Abstract Only
B. Groundwater, M. F. Lembeck, L. Sarsfield (Science Applications International Corp., Wayne, PA.), and Alphonso Diaz *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 67 (For primary document see N89-15549 07-61)
(Contract NASw-4092)
Avail: NTIS HC A21/MF A01 CSCL 05A

N89-15578*# Alabama Univ., Huntsville. Dept. of MIS/MSC.
A KNOWLEDGE-BASED DECISION SUPPORT SYSTEM FOR PAYLOAD SCHEDULING
Rajesh Tyagi and Fan T. Tseng *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 207-210 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 05A

N89-15591*# Arizona Univ., Tucson. Dept. of Electrical and Computer Engineering.
DESIGN OF A SIMULATION ENVIRONMENT FOR LABORATORY MANAGEMENT BY ROBOT ORGANIZATIONS
Bernard P. Zeigler, Francois E. Cellier, and Jerzy W. Rozenblit *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 313-321 (For primary document see N89-15549 07-61)
(Contract NCC2-525)
Avail: NTIS HC A21/MF A01 CSCL 05A

N89-15603*# General Electric Co., Philadelphia, PA.
AUTOMATIC SCHEDULING AND PLANNING (ASAP) IN FUTURE GROUND CONTROL SYSTEMS
Sam Matlin *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 421-430 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 05A

N89-15604*# Carleton Univ., Ottawa (Ontario). School of Computer Science.
A DYNAMIC CASE-BASED PLANNING SYSTEM FOR SPACE STATION APPLICATION
F. Oppacher and D. Deugo *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 431-439 Sponsored in part by the Canadian Space Station Program Office of the National Research Council (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 05A

N89-15610*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
CONSIDERATIONS IN DEVELOPMENT OF EXPERT SYSTEMS FOR REAL-TIME SPACE APPLICATIONS
S. Murugesan *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 487-496 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 05A

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

N89-15773 Clarkson Univ., Potsdam, NY.
GLOBAL UPDATES IN INTEGRATION OF DISTRIBUTED DATABASES Ph.D. Thesis
M. Samy Mohamed Gamal-Eldin 1988 212 p
Avail: Univ. Microfilms Order No. DA8808024

Applications such as C3I (command, control, communication, and information) systems, banking, and reservation systems are strategic systems. It is desirable to allow updates to distributed data in real time, in addition to having a true conceptual global schema which represents the whole distributed system. Such strategic systems can be created by building a global integration of distributed databases. The problem of integrating separate local databases in a network into a single distributed database, with particular attention to supporting updates in such an integrated database is considered. Constructing methods for update processing in distributed databases requires the solution of problems of relationship among attributes, schema mapping, constraint integration, and update translation. These four problems are addressed in the context of integrating separate databases, all of which are based on the relational data model, or at least have a relational interface to them. Within this context, several problems are addressed: attribute equivalence; embedded attributes; embedded attributes of locality; attribute-locality mappings; locality dependency; 2-dimensional union; global constraints; and globally contradictory constraints. Dissert. Abstr.

N89-15774 Maryland Univ., College Park.
ON QUERY PROCESSING IN DISTRIBUTED DATABASE SYSTEMS Ph.D. Thesis
Hyunchul Kang 1987 113 p
Avail: Univ. Microfilms Order No. DA8808565

Processing a query in distributed data base systems requires data transmission among the different sites of the computer network. The optimization of data transmission cost is the major concern in distributed query processing. To optimize the amount of data transmission, the semijoin was used as an effective operator for reducing relations before they are transmitted for the final joins. A new approach is proposed for distributed query optimization which is based on combining semijoins and joins. First, simulation results are reported which indicate that such a semijoin-join integrated approach would be more effective than a solely semijoin-based approach. Then, a semijoin-join integrated query optimization technique and an algorithm SMJ+J for generating a semijoin-join program, a sequence of semijoins and/or joins is presented. An optimal semijoin-join program is derived for a single join query, and the single join query optimization is used as the basis for generating an efficient semijoin-join program for a general join query. The performance of the semijoin-join program is evaluated. Some extensions to the proposed optimization technique are also considered. Dissert. Abstr.

N89-15775# Department of Defense, Washington, DC. Office of the Inspector General.
ACQUISITION ALERTS FOR PROGRAM MANAGERS
Sep. 1987 45 p
(PB88-223268; DOD-4245.1-H) Avail: NTIS HC A03/MF A01 CSCL 05B

The primary objective of the publication is to assist in preventing problems during the acquisition process by alerting the acquisition manager to problem areas (past and present) where the acquisition manager must take certain actions and/or ensure the acquisition manager seeks expert advice. The booklet serves as a quick and easy reference guide, although it does not answer all questions. The publication contains five sections: contracting procedures, personal conduct and actions, historical problems in acquisition, a glossary, and topical references. Author

N89-15776*# National Aeronautics and Space Administration, Washington, DC.
CONSULTATIVE COMMITTEE FOR SPACE DATA SYSTEMS RECOMMENDATION FOR SPACE DATA SYSTEM STANDARDS: STANDARD FORMATTED DATA UNITS - STRUCTURE AND CONSTRUCTION RULES
Feb. 1988 22 p Prepared in cooperation with CNES, Paris, France, DFVLR, Berlin, Fed. Republic of Germany, ESA, Paris, France, ISRO, Bangalore, India, INPE, Sao Jose dos Campos, Brazil and NASDA, Tokyo, Japan
(NASA-TM-101216; Blue-Book-Issue-1; CCSDS-620.0-B-1; NAS 1.15:101216) Avail: NASA, Washington, DC, Code TS CSCL 05B

A technical recommendation is presented for the standardization of the structure and construction rules of Standard Formatted Data Units (SFDU) for the interchange of digital space related data in an open data system. This recommendation defines an SFDU structure that will handle problems of digital data interchange and construction rules that will limit the SFDUs to a practical set that can exist in an open data system environment. It allows implementing organizations within each Agency to proceed coherently with the development of compatibly derived Standards for space data systems and widely dispersed data users that are within their cognizance. Author

N89-15777*# National Aeronautics and Space Administration, Washington, DC.
CONSULTATIVE COMMITTEE FOR SPACE DATA SYSTEMS RECOMMENDATION FOR SPACE DATA SYSTEM STANDARDS: TIME CODE FORMATS
Jan. 1987 33 p Prepared in cooperation with CNES, Paris, France, DFVLR, Berlin, Fed. Republic of Germany, ESA, Paris, France, ISRO, Bangalore, India, INPE, Sao Jose dos Campos, Brazil and NASDA, Tokyo, Japan
(NASA-TM-101215; Blue-Book-Issue-1; CCSDS-301.0.B-1; NAS 1.15:101215) Avail: NASA, Washington, DC, Code TS CSCL 05B

A technical recommendation is presented for time code formats. The set of time code formats described is the baseline concept for time representation in data interchange applications that are cross supported between agencies of the CCSDS. A common framework is established and a common basis is provided for the formats of time code data. It allows implementing organizations within each agency to proceed coherently with the development of compatible derived standards for the flight and ground systems that are within their cognizance. Derived agency standards may implement only a subset of the optional features allowed by the recommendation and may incorporate features not addressed by this recommendation. Author

N89-15778*# National Aeronautics and Space Administration, Washington, DC.
CONSULTATIVE COMMITTEE FOR SPACE DATA SYSTEMS RECOMMENDATION FOR SPACE DATA SYSTEM STANDARDS: RADIO METRIC AND ORBIT DATA
Jan. 1987 15 p Prepared in cooperation with CNES, Paris, France, DFVLR, Berlin, Fed. Republic of Germany, ESA, Paris, France, ISRO, Bangalore, India, INPE, Sao Jose dos Campos, Brazil and NASDA, Tokyo, Japan
(NASA-TM-101214; Blue-Book-Issue-1; CCSDS-501.0-B-1; NAS 1.15:101214) Avail: NASA, Washington, DC, Code TS CSCL 05B

A technical recommendation is presented for standardization of radio metric and orbit data generated by space data systems. The topics covered include radio metric data, spacecraft orbital elements, solar system ephemeris, tracking station locations, astrometric data, reference systems, astrodynamic constants and spacecraft dynamics parameters. This recommendation deals explicitly with the technical definitions and conventions associated

with inter-agency cross support situations involving the transfer of orbital elements and ground based conventional radio metric data, i.e., Doppler and range. Author

N89-15779*# National Aeronautics and Space Administration, Washington, DC.
THE NASA SCIENTIFIC AND TECHNICAL INFORMATION SYSTEM: ITS SCOPE AND COVERAGE
Dec. 1988 216 p
(NASA-SP-7065; NAS 1.21:7065) Avail: NTIS HC A10/MF A01 CSCL 05B

A general description of the subject areas covered in the NASA scientific and technical information system is presented. In addition, it establishes subject-based selection criteria for guiding decisions related to the addition of new documents to the NASA collection. Author

N89-15780 California Univ., Berkeley.
CLIENT/SERVICE PROVIDER PERCEPTIONS OF REFERENCE SERVICE OUTCOMES IN ACADEMIC LIBRARIES: EFFECTS OF FEEDBACK AND UNCERTAINTY Ph.D. Thesis
Jo Bell Whitlatch 1987 388 p
Avail: Univ. Microfilms Order No. DA8814115

The principal focus concerns client participation in academic libraries. A model of the major variables influencing academic library reference service outcomes is tested. This model is based primarily on the boundary spanning theory. Organizational boundaries can be expected to create perceptual differences between clients and service providers in evaluating information services. Additional theories form the field or organizational behavior used in developing the model are: communication, social exchange, socialization, feedback, uncertainty, and organizational effectiveness. Independent variables included in the model are: client socialization, service orientation, feedback, time constraints, task uncertainty, size, discipline paradigm, and type of assistance. The dependent variables or service outcomes are: librarian value of service outcomes, user value of service outcomes, and user success in locating needed materials. The study also identifies user and reference librarian differences in perceptions for the following service outcomes: general quality of service, relevance of information, and amount of information. Dissert. Abstr.

N89-15781# Naval Postgraduate School, Monterey, CA.
TEMPORAL DATA, TEMPORAL DATA MODELS, TEMPORAL DATA LANGUAGES AND TEMPORAL DATABASE SYSTEMS M.S. Thesis
Donald D. Horn Jun. 1988 70 p
(AD-A199965) Avail: NTIS HC A04/MF A01 CSCL 12G

The study of temporal database systems is relatively new in the field of computer science. Two developments have led to the present interest. The advances of the storage technology for large amounts of data and applications's requirement for time-dependent data have prompted our study of temporal databases. This thesis conducts a survey of the major research areas concerning temporal databases. Temporal data, taxonomies of temporal data models, temporal data languages, and temporal database systems are presented. It is argued here that future database systems should handle the temporal domain by an integrated temporal database system. By understanding the present technology and the need of temporal database systems, our research in the area of real-time temporal database systems can begin. It is the purpose of this thesis to provide the background information and research references of temporal database systems as a first step towards the real-time database system research. Real-time database systems are time-constrained and temporally constituted. Solutions in temporal database systems can contribute to the design of real-time military applications using temporal databases. GRA

N89-15782# Naval Postgraduate School, Monterey, CA.
RECENT NAVAL POSTGRADUATE SCHOOL PUBLICATIONS Summary Report, 1 Oct. 1986 - 30 Sep. 1987
30 Aug. 1988 332 p
(AD-A199164; NPS012-88-002) Avail: NTIS HC A15/MF A01 CSCL 05B

This publication contains a listing for each faculty member from each department indicating the conference presentations, contributions to books, published papers, and technical reports for the years 1984 to 1987. Citations are provided for members of the following departments: Administrative sciences; Aeronautics; Computer science; Electrical and computer engineering; Mathematics; Mechanical engineering; Meteorology; National security affairs; Oceanography; Operations research; Physics; and Defense Resources Management Education Center. GRA

N89-15783# Naval Postgraduate School, Monterey, CA.
A SUMMARY OF THE NAVAL POSTGRADUATE SCHOOL RESEARCH PROGRAM Summary Report, 1 Oct. 1986 - 30 Sep. 1987
30 Aug. 1988 380 p
(AD-A199165; NPS012-88-003) Avail: NTIS HC A17/MF A01 CSCL 05B

This report contains 198 summaries of research projects which were carried out under funding to the Naval Postgraduate School Research Program. This research was conducted under the areas of Computer Science, Mathematics, Administrative Sciences, Operations Research, National Security Affairs, Physics, Electrical and Computer Engineering, Meteorology, Aeronautics and Astronautics, Oceanography, and Mechanical Engineering. GRA

N89-15784# Naval Postgraduate School, Monterey, CA.
COMPILATION OF ABSTRACTS OF THESES SUBMITTED BY CANDIDATES FOR DEGREES Summary Report, 1 Oct. 1986 - 30 Sep. 1987
30 Aug. 1988 801 p
(AD-A199166; NPS012-88-001) Avail: NTIS HC A99/MF A02 CSCL 05B

This publication contains the abstracts of theses submitted during the period 1 October 1986 to 30 September 1987 by candidates for Doctoral, Master's and Engineer's degrees at the Naval Postgraduate School, Monterey, CA 93943. Subject areas include: Computers; Operations research; Navigation; Fluid dynamics; Naval aircraft computer programs; Communication systems; Mechanical engineering; Metallurgy; Weapon systems; Antimissile defense systems; Space systems; Combustion; Display systems; Logistics; Electronics; Optics; Antennas; Electrical engineering; Acoustics Information System; Systems management. GRA

N89-15785# Naval Postgraduate School, Monterey, CA.
A CONCEPTUAL DESIGN OF A MULTIMEDIA DBMS (DATABASE MANAGEMENT SYSTEM) FOR ADVANCED APPLICATIONS Summary Report, Jul. 1987 - Jun. 1988
Vincent Y. Lum and Klaus Meyer-Wegener Aug. 1988 31 p
(AD-A199548; NPS52-88-025) Avail: NTIS HC A03/MF A01 CSCL 05B

Managing Multimedia Data is becoming more and more important. There are already various operational systems for this task, but they are usually built as special-purpose systems and lack the general capability as exhibited in a database management system (DBMS), suitable for a wide variety of applications. This paper argues that DBMS should be extended to manage multimedia data as well as the standard structured data, exploiting all the established techniques and providing the new data types to all applications. The paper examines the characteristics of multimedia data and outlines some of the current research projects in this area. It recognizes the significant and successful applications of the database technology and information retrieval techniques developed in the last two decades and proposes to capitalize on these advances to develop a DBMS for handling multimedia data. The paper also sketches some directions where future research may be headed to solve the complex issues in multimedia data processing. GRA

N89-15786# Naval Postgraduate School, Monterey, CA.
IMAGE DATABASE MANAGEMENT IN A MULTIMEDIA SYSTEM Progress Report, Mar. - Jun. 1988
Klaus Meyer-Wegener, Vincent Y. Lum, and C. T. Wu Aug. 1988 26 p
(AD-A199561; NPS52-88-024) Avail: NTIS HC A03/MF A01 CSCL 12G

A general concept for the representation of multimedia data by unformatted and formatted data is introduced. It leads to a basic-function approach to the design and development of multimedia database systems, which extends a relational database management system with new attribute types. In this paper, raster (or bitmap) images are used as an example. The structure of image values is defined, and a basic set of operations for access and manipulation is proposed. These operations can be integrated into a query language like SQL. To facilitate a contents-oriented search on multimedia data in general and on images in particular, text descriptions are introduced into the database that allow users to indicate the contents of an image. The well established techniques of information retrieval can be applied to search for these descriptions. The proposed system allows us to model images that are assigned to objects as well as stand-alone images. The paper finally sketches a prototype implementation on top of an existing relational database management system (Ingres).
GRA

N89-15787# Oak Ridge National Lab., TN. Data Systems Research and Development Program.
USERS MANUAL FOR THE RESEARCH NOTES SYSTEM (VERSION 1.5)
Dean S. Hartley, III May 1988 207 p
(Contract DE-AC05-84OR-21400)
(DE89-001391; ORNL/DSRD/TM-18) Avail: NTIS HC A10/MF A01

The purpose of the Research Notes System (RNS) is to help collect and organize information. The information the RNS manages consists of notes which are typed into the system, references to the source of the note, and subject classifications of the note. The RNS may be used to organize the reference material (books, reprints of papers, etc.) which researchers typically accumulate, or it may be used in a directed search for a project, or both. The Research Notes System is a set of dBASE III programs and relational databases which meets this need. The RNS provides ease of data entry through the use of relational databases to minimize redundant data entry. The information is organized by keying each note to one or more user-defined subjects. The RNS also provides several retrieval methods for use during intermediate research phases and in the final-article writing phase. The RNS provides an update function so that a Master RNS may be maintained with multiple users of RNS copies. This document details the procedures necessary to use the RNS. Areas covered include benefits, input data dictionaries and tips on using the RNS, as well as detailed operating instructions. The operating instructions describe each operating step and each option with complete illustrations of the screen prompts and displays. The installation section describes how to use the system on a hard disk (the recommended hardware for the system) and on floppy disks.
DOE

N89-15788# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil). Artificial Intelligence Group.
TOWARDS A KNOWLEDGE-BASED SYSTEM TO ASSIST THE BRAZILIAN DATA-COLLECTING SYSTEM OPERATION
Valter Rodrigues, Paulo OuveraSimoni, Pedro Paulo BdeOliveira, Carlos AlbertodeOliveira, and Carlos Antonio MarquesNogueira Sep. 1988 13 p Presented at the 4th Conference on Artificial Intelligence for Space Applications, Huntsville, AL, 15-16 Nov. 1988
(INPE-4707-PRE/1389) Avail: NTIS HC A03/MF A01

A study is described to show how a knowledge-based approach would lead to a flexible tool to assist the operational task in a satellite-based environmental data collection effort. Some characteristics of a hypothetical system comprised of a satellite and a network of Interrogable Data Collecting Platforms (IDCPs) are pointed out. The Knowledge-Based Planning Assistant System (KBPAS) is briefly described as well as how knowledge is organized in the IDCP domain.
Author

N89-15789*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AN EVALUATION OF SELECTED NASA SCIENTIFIC AND TECHNICAL INFORMATION PRODUCTS: RESULTS OF A PILOT STUDY
Thomas E. Pinelli and Myron Glassman (Old Dominion Univ., Norfolk, VA.) Jan. 1989 95 p
(Contract NAS1-18584)
(NASA-TM-101533; NAS 1.15:101533) Avail: NTIS HC A05/MF A01 CSCL 05B

A pilot study was conducted to evaluate selected NASA scientific and technical information (STI) products. The study, which utilized survey research in the form of a self-administered mail questionnaire, had a two-fold purpose -- to gather baseline data regarding the use and perceived usefulness of selected NASA STI products and to develop/validate questions that could be used in a future study concerned with the role of the U.S. government technical report in aeronautics. The sample frame consisted of 25,000 members of the American Institute of Aeronautics and Astronautics in the U.S. with academic, government or industrial affiliation. Simple random sampling was used to select 2000 individuals to participate in the study. Three hundred fifty-three usable questionnaires (17 percent response rate) were received by the established cutoff date. The findings indicate that: (1) NASA STI is used and is generally perceived as being important; (2) the use rate for NASA-authored conference/meeting papers, journal articles, and technical reports is fairly uniform; (3) a considerable number of respondents are unfamiliar with STAR (Scientific and Technical Aerospace Reports), IAA (International Aerospace Abstracts), SCAN (Selected Current Aerospace Notices), and the RECON on-line retrieval system; (4) a considerable number of respondents who are familiar with these media do not use them; and (5) the perceived quality of NASA-authored journal articles and technical reports is very good.
Author

N89-15555*# Phase Linear Systems, Inc., Fairfax, VA.
KAM (KNOWLEDGE ACQUISITION MODULE): A TOOL TO SIMPLIFY THE KNOWLEDGE ACQUISITION PROCESS
Gary A. Gettig *In* NASA, Marshall Space Flight Center, Fourth Confnce on Artificial Intelligence for Space Applications Oct. 1988 p 47-55 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 05B

N89-15573*# Alabama Univ., Huntsville. Dept. of Computer Science.
EXTENDING THE DATA DICTIONARY FOR DATA/KNOWLEDGE MANAGEMENT
Cecile L. Hydrick and Sara J. Graves *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 173-181 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 05B

N89-15574*# Martin Marietta Aerospace, New Orleans, LA. Manned Space Systems.
CASE-BASED REASONING: THE MARRIAGE OF KNOWLEDGE BASE AND DATA BASE
Kirt Pulaski and Cyprian Casadaban *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 183-190 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 05B

N89-15585*# Prospective Computer Analysts, Inc., Arlington, VA.
AUTOMATED KNOWLEDGE BASE DEVELOPMENT FROM CAD/CAE DATABASES
R. Glenn Wright and Mary Blanchard *In* NASA, Marshall Space

Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 253-260 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 05B

N89-15605*# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil). Computing and Applied Mathematics Lab.
TOWARDS A KNOWLEDGE-BASED SYSTEM TO ASSIST THE BRAZILIAN DATA-COLLECTING SYSTEM OPERATION
Valter Rodrigues, P. O. Simoni, P. P. B. Oliveira, C. A. Oliveira, and C. A. M. Nogueira *In* NASA, Marshall Space Flight Center, Fourth Conference on Artificial Intelligence for Space Applications Oct. 1988 p 441-449 (For primary document see N89-15549 07-61)
Avail: NTIS HC A21/MF A01 CSCL 05B

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

No abstracts in this category.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

No abstracts in this category.

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

No abstracts in this category.

88 SPACE SCIENCES (GENERAL)

N89-15790*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
SPACE STATION INDUCED MONITORING
James F. Spann, ed. and Marsha R. Torr, ed. Washington, DC Nov. 1988 85 p Conference held in Huntsville, AL, 10-11 May 1988 Sponsored by NASA, Washington
(NASA-CP-3021; M-602; NAS 1.55:3021) Avail: NTIS HC A05/MF A01 CSCL 22B

This report contains the results of a conference convened May 10-11, 1988, to review plans for monitoring the Space Station induced environment, to recommend primary components of an induced environment monitoring package, and to make recommendations pertaining to suggested modifications of the Space Station External Contamination Control Requirements Document JSC 30426. The contents of this report are divided as Follows: Monitoring Induced Environment - Space Station Work Packages Requirements, Neutral Environment, Photon Emission Environment, Particulate Environment, Surface Deposition/ Contamination; and Contamination Control Requirements. For individual titles, see N89-15791 through N89-15802.

N89-15791*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SUMMARY OF REQUIREMENTS IN NASA WORK PACKAGE NO. 2 **c18**
L. Leger and H. Ehlers *In* NASA, Marshall Space Flight Center, Space Station Induced Monitoring Nov. 1988 p 1-4 (For primary document see N89-15790 07-88)
Avail: NTIS HC A05/MF A01 CSCL 22B

Work package No. 2 (WP2) has a section in the proposal dealing with measurements of the environment. The quantities to be measured as well as the instruments to be used are summerized. The information provided is only a cursory overview of what has been considered at the time of the proposal. Nevertheless the general ideas are given that much work needs to be done to develop specifics. It is important to note that measurements in the field of particles and waves are not part of the proposal. On the other hand, some of the environmental measurements planned and included in the proposal do not fall within the category of contamination. Some concepts of environment monitoring configurations are also given. Author

N89-15792*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
ENVIRONMENTAL MONITORING FOR SPACE STATION WP01 **c18**
J. M. Zwiener *In its* Space Station Induced Monitoring Nov. 1988 p 5-12 (For primary document see N89-15790 07-88)
Avail: NTIS HC A05/MF A01 CSCL 22B

External contamination monitoring instrumentation for the Space Station work package one (WP01) elements, were imposed on the contractor as deliverable hardware. The monitoring instrumentation proposed by the WP01 contractor in response to the contract requirement includes both real time measurements and passive samples. Real time measurement instrumentation consists of quartz crystal microbalances for molecular deposition, ion gaseous species identification. Internal environmental contamination monitoring for particulates is included in both Lab and HAB modules. Passive samples consists of four sample mounting plates mounted external to the Space Station modules, two on the U.S. LAB, and two on the HAB module. Author

N89-15793*# TS Infosystems, Lanham, MD.
GSFC CONTAMINATION MONITORS FOR SPACE STATION **c18**
P. A. Carosso, J. L. Tveekrem, and J. D. Coopersmith *In* NASA, Marshall Space Flight Center, Space Station Induced Monitoring Nov. 1988 p 13-17 (For primary document see N89-15790 07-88)
Avail: NTIS HC A05/MF A01 CSCL 22B

This paper describes the Work Package 3 activities in the area of neutral contamination monitoring for the Space Station. Goddard Space Flight Center's responsibilities include the development of the Attached Payload Accommodations Equipment (APAE), the Polar Orbiting Platform (POP), and the Flight Telerobotic Servicer (FTS). GSFC will also develop the Customer Servicing Facility (CSF) in Phase 2 of the Space Station. Author

N89-15794*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
PLASMA INTERACTIONS MONITORING SYSTEM **c18**
William T. Roberts *In its* Space Station Induced Monitoring Nov. 1988 p 19-25 (For primary document see N89-15790 07-88)
Avail: NTIS HC A05/MF A01 CSCL 22B

The plasma environment around the space station is expected

to be different from that environment which occurs naturally at these altitudes because of the unprecedented size of the space station, its orbital motion, and its high power distribution system. Although there are models which predict the environment around the station, they do not take into account changes in configuration, changes in the natural and induced environments, nor interactions between the different environments. There will be unique perturbations associated with the space station, which will vary as the space station is being developed. Even after the developed space station has been completed environmental conditions will change as the payloads are changed and as the station systems and materials undergo degradation and modification. Because the space station will be a point of many varied activities the environment will continually undergo perturbations from effluents resulting from operations of the reboost module, EVA, airlock operations, and vacuum venting. The use of the Mobile Service Center will cause disturbances which cannot, at this time, be predicted. Also, the natural environment will be affected by solar flares. In addition, the operations of attached payloads, (e.g., ASTROMAG) themselves will undoubtedly cause perturbations to the ambient environment. Finally, the natural environment will change as a result of natural perturbations such as solar flares and geomagnetic storms. Author

N89-15795*# Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.

THE SPACE STATION NEUTRAL GAS ENVIRONMENT AND THE CONCOMITANT REQUIREMENTS FOR MONITORING **c18**

George Carignan *In* NASA, Marshall Space Flight Center, Space Station Induced Monitoring Nov. 1988 p 27-28 (For primary document see N89-15790 07-88)

Avail: NTIS HC A05/MF A01 CSCL 22B

At 340 km, for typical conditions, the neutral atmospheric density is several times 10E8/cc and is thus more abundant than the ionized component by several factors of 10. At that altitude, the principal series is atomic oxygen with 10 percent N2, and 1 percent He, and trace amounts of O2, H, N, NO, and Ar. The constituent densities are highly variable with local time, latitude, and geophysical indices. The physical interaction with surfaces at orbital velocity leads to large buildup of density on forward faces and great depletions in the wakes of objects. Chemical reactions lead to major modifications in constituent densities as in the case of the conversion of most colliding oxygen atoms to oxygen bearing molecules. The neutral environment about an orbiting body is thus a complex product of many variables even without a source of neutral contaminants. The addition of fluxes of gases emanating from the orbiting vehicle, as will be the case for the Space Station, with the associated physical and chemical interactions adds another level of complexity to the character of the environment and mandates a sophisticated measurement capability if the neutral environment is to be quantitatively characterized. Author

N89-15796*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

A COMPACT IMAGING SPECTROMETER FOR STUDIES OF SPACE VEHICLE INDUCED ENVIRONMENT EMISSIONS **c18**

Marsha R. Torr, ed. and D. G. Torr (Alabama Univ., Huntsville.) *In its* Space Station Induced Monitoring Nov. 1988 p 31-38 (For primary document see N89-15790 07-88)

Avail: NTIS HC A05/MF A01 CSCL 22B

On the basis of spectral measurements made from the Space Shuttle and on models of the possible Space Station external environment, it appears likely that, even at the planned altitudes of Space Station, photon emissions will be induced. These emissions will occur to some degree throughout the UV-visible-IR spectrum. The emissions arise from a combination of processes including gas phase collisions between relatively energetic ambient and surface emitted or re-emitted atoms or molecules, where the surface raises some species to excited energy states. At present it is not possible to model these processes or the anticipated intensity levels with accuracy, as a number of fundamental parameters needed for such calculations are still poorly known or unknown. However, it is possible that certain spectral line and band features will exceed the desired goal that contaminant emissions not exceed the natural zodiacal background. However, in the near infrared and infrared, it appears that this level will be exceeded to a significant degree. Therefore it will be necessary to monitor emission levels in the vicinity of Space Station, both in order to establish the levels and to better model the environment. In this note, we briefly describe a small spectrometer that is suitable for monitoring the spectrum from 1200A to less than or approximately 12,000A. This instrument uses focal plane array detectors to image this full spectral range simultaneously. The spectral resolution is 4 to 12A, depending on the portion of the wavelength range. Author

N89-15797*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

INFRARED MONITORING OF THE SPACE STATION ENVIRONMENT **c18**

Theodor Kostiuk, Donald E. Jennings, and Michael J. Mumma *In* NASA, Marshall Space Flight Center, Space Station Induced Monitoring Nov. 1988 p 39-46 (For primary document see N89-15790 07-88)

Avail: NTIS HC A05/MF A01 CSCL 22B

The measurement and monitoring of infrared emission in the environment of the Space Station has a twofold importance - for the study of the phenomena itself and as an aid in planning and interpreting Station based infrared experiments. Spectral measurements of the infrared component of the spacecraft glow will, along with measurements in other spectral regions, provide data necessary to fully understand and model the physical and chemical processes producing these emissions. The monitoring of the intensity of these emissions will provide background limits for Space Station based infrared experiments and permit the determination of optimum instrument placement and pointing direction. Continuous monitoring of temporal changes in the background radiation (glow) will also permit better interpretation of Station-based infrared earth sensing and astronomical observations. The primary processes producing infrared emissions in the Space Station environment are: (1) Gas phase excitations of Station generated molecules (e.g., CO2, H2O, organics...) by collisions with the ambient flux of mainly O and N2. Molecular excitations and generation of new species by collisions of ambient molecules with Station surfaces. They provide a list of resulting species, transition energies, excitation cross sections and relevant time constants. The modeled spectrum of the excited species occurs primarily at wavelengths shorter than 8 micrometer. Emissions at longer wavelengths may become important during rocket firing or in the presence of dust. Author

N89-15798*# Physical Sciences, Inc., Andover, MA. Applied Sciences.

REQUIREMENTS FOR PARTICULATE MONITORING SYSTEM FOR SPACE STATION **c18**

Byron David Green *In* NASA, Marshall Space Flight Center, Space Station Induced Monitoring Nov. 1988 p 47-49 (For primary document see N89-15790 07-88)

Avail: NTIS HC A05/MF A01 CSCL 22B

We recommend that a stereo camera system be utilized as a diagnostic for the particulate environment surrounding the Space Station. This system should have sufficient sensitivity to identify contaminated periods, to isolate the effects of sources and activities and to determine optical clearing times. A reasonable compromise between sensitivity and other operational constraints is recommended. Sensitivity comparable to the film camera systems should suffice, but long periods of unattended operation and remotely controlled exposure sequences are essential requirements. Author

N89-15799*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

SPACE STATION SURFACE DEPOSITION MONITORING **c18**

E. R. Miller *In its* Space Station Induced Monitoring Nov.

1988 p 51-57 (For primary document see N89-15790 07-88)
Avail: NTIS HC A05/MF A01 CSCL 22B

Quartz crystal microbalance sensors are recommended to verify and monitor surface deposition on the early transverse boom as well as the later dual-keel Space Station configurations. Performance and placement of these sensors are discussed and compared to imposed maximum mass deposition rate requirements at the science instrument and critical power locations. Additional measurements are suggested to gain further knowledge on properties of the deposited material. Author

N89-15800*# Science and Engineering Associates, Inc., Englewood, CO.
CONTAMINATION CONTROL REQUIREMENTS DOCUMENT JSC 30426 RECOMMENDED UPDATES c18
Ray Rantanen *In* NASA, Marshall Space Flight Center, Space Station Induced Monitoring Nov. 1988 p 59-69 (For primary document see N89-15790 07-88)
Avail: NTIS HC A05/MF A01 CSCL 22B

Contamination control requirements for the Space Station have been evolving over the last few years. Workshops, comments by experimenters and continuing analysis have resulted in recommending changes to the November 19, 1986 version of Space Station External Contamination Control Requirements, JSC 30426. These are summarized and presented, so that the requirements can be revised as soon as possible, to minimize costly design impacts on the Space Station. Author

N89-15801*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
DISPOSITION OF RECOMMENDED MODIFICATIONS OF JSC 30426 c18
James F. Spann, ed. *In its* Space Station Induced Monitoring Nov. 1988 p 71-76 (For primary document see N89-15790 07-88)
Avail: NTIS HC A05/MF A01 CSCL 22B

On May 11, 1988 changes and additions to the Space Station External Contamination Control Document JSC 30426 were addressed at length as part of the charter of this workshop. The modifications and disposition thereof are given below in a concise form in order that a clear understanding of the recommendations and current status be presented. The format is that each paragraph under question is given along with the proposed modified paragraph followed by the workshop's disposition. In some cases, a brief explanation of the issue is given prior to the paragraph in question. Author

N89-15802*# Alabama Univ., Huntsville. Dept. of Electrical and Computer Engineering.
ARCING AND DISCHARGES IN HIGH-VOLTAGE SUBSYSTEMS OF SPACE STATION c18
N. Singh *In* NASA, Marshall Space Flight Center, Space Station Induced Monitoring Nov. 1988 p 77-81 (For primary document see N89-15790 07-88)
Avail: NTIS HC A05/MF A01 CSCL 22B

Arcing and other types of electrical discharges are likely to occur in high-voltage subsystems of the Space Station. Results from ground and space experiments on the arcing of solar cell arrays are briefly reviewed, showing that the arcing occurs when the conducting interconnects in the arrays are at negative potential above a threshold, which decreases with the increasing plasma density. Furthermore, above the threshold voltages the arcing rate increases with the plasma density. At the expected operating voltages (approximately 200 V) in the solar array for the space station, arcing is expected to occur even in the ambient ionospheric plasma. If the ionization of the contaminants increases the plasma density near the high-voltage systems, the adverse effects of arcing on the solar arrays and the space station are likely to be enhanced, In addition to arcing other discharge processes are likely to occur in high-voltage subsystems. For example, Paschen discharge is likely to occur when the neutral density N sub n greater that 10 to the 12th cu cm, the corresponding neutral pressure P greater than 3 x 10 to the -5 Torr. Author

89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

N89-15803 California Inst. of Tech., Pasadena.
AN ACOUSTO-OPTICAL CORRELATION SPECTROMETER FOR RADIO ASTRONOMY Ph.D. Thesis
Kwok-wai Cheung 1987 156 p
Avail: Univ. Microfilms Order No. DA8803391

The objective is to develop and construct a wide-band, high resolution, two-channel prototype acousto-optic correlation spectrometer (AOCS) to analyze signals received by the three element millimeter-wave interferometer at the Caltech Owens Valley Radio Observatory (OVRO) which may be used to study the distribution of carbon monoxide and other molecules in the galaxy. The proposed correlation spectrometer has the main advantage of large time-bandwidth products and hence of low cost per frequency channel. Thus, it is suitable for many scientific objectives that require both large bandwidth and high resolution. Phase switching was used to reduce the zero level variation of this instrument, and was found to be more effective than other schemes used by the single dish acousto-optic spectrometers. Both the frequency resolution and the frequency coverage of this instrument can be changed easily, and give it a flexibility not attainable by the filter-bank spectrometers. An absolute calibration of the instrument was attempted by using the system temperature as a scale for both the correlated signal received and the noise fluctuation of the instrument. A statistical method was used to measure the various noise contributions of the instrument, which allows a very precise characterization of the zero level stability and the noise degradation of the system. The instrument can be used to measure any RF spectrum and the cross spectrum of any two RF signals. Since it is a time integrating device, its sensitivity can be as high as one desires. Dissert. Abstr.

N89-15804 Durham Univ. (England).
OPTICAL POLARIMETRY OF STAR FORMING REGIONS Ph.D. Thesis
Timothy Michael Gledhill 1987 201 p
Avail: Univ. Microfilms Order No. BRD-81355

Nebulosity associated with low mass pre-main sequence (PMS) stellar objects was investigated polarimetrically. Three regions of on-going star formation are considered, specifically, the Haro 6-5 and the HL/XZ Tau systems (both associated with dark clouds in the Taurus complex) and the PV Cephei nebulosity near NGC7023. The work is based on CCD observations at optical wavelengths using the Durham imaging polarimeter. Theories of PMS stellar evolution have developed rapidly over the last three years in tandem with observational discoveries and so a review of current ideas, necessary for the interpretation of the data, is given. The viability of the Davis-Greenstein grain alignment mechanism in regions of star formation is also briefly examined. In each region, the imaging observations suggest bipolarity in the optical structure of the nebulosity and the polarimetric data are used to determine the locations of the illuminating sources. Evidence is found for the association of circumstellar discs of obscuration with the PMS objects Haro 6-5A (FS Tau), Haro 6-5B, HL Tau, and PV Cephei. Examination of the source region polarization maps suggests that at least one of the objects considered is surrounded by a dust grain-aligning magnetic field which has a predominantly toroidal geometry in the plane of the circumstellar disc and the implications for current theories of outflow acceleration and cloud evolution are discussed. Dissert. Abstr.

N89-15805 Wisconsin Univ., Madison.
OBSERVATIONS OF THE DIFFUSE SOFT X-RAY BACKGROUND FROM 0.07 TO 1.0 keV Ph.D. Thesis
Jeffrey Joseph Bloch 1988 311 p
Avail: Univ. Microfilms Order No. DA8801462

Results of a sounding rocket flight that observed the very soft X-ray diffuse background in a section of the northern galactic hemisphere are reported. The instrument included a gas proportional counter with Be filters that defined an X-ray bandpass

from approx. 0.078 to 0.111 keV (Be band). The ratio of the measured Be band count rate to the sky survey B bound count rates shows no significant variations with position. This proportionality exists over an arc extending 120 deg on the sky and over more than a factor of two in count rate, strongly suggesting a common emission mechanism for both Be and B band X-rays. The pulse height spectra of the Be band data are also analyzed. The Be band pulse height distribution does not significantly vary in shape among the positions examined. The data are consistent with a single 96.5 + or - 2.5 eV emission line producing all of the flux in the 0.078 to 0.111 keV energy range. The pulse height data are also consistent with any continuous or multi-line spectrum having the same band response weighted effective energy. The data are compared to standard plasma emission models.
Dissert. Abstr.

N89-15806*# Smithsonian Astrophysical Observatory, Cambridge, MA.
ASTROMETRIC OBSERVATIONS OF COMETS AND ASTEROIDS AND SUBSEQUENT ORBITAL INVESTIGATIONS
Semiannual Progress Report No. 30, 1 May - 31 Oct. 1988
Richard E. McCroskey and Brian G. Marsden Nov. 1988 9 p
(Grant NGR-09-015-212)
(NASA-CR-183000; NAS 1.26:183000) Avail: NTIS HC A02/MF A01 CSCL 03A

The 155-cm reflector was used for observations of comets and minor planets on 28 nights during April-October. Twenty-two of the observations refer to comets, 62 to numbered minor planets (numbered, that is, by the end of the semester: only nine of them refer to minor planets already numbered at the time of the last report), and the remainer to unnumbered minor planets. Observations were made of four new comets discovered during the semester and a fifth discovered in January. Observations of Wilson (19861), P/Tempel 2 and two other returning short-period comets are also continuing. Among the odd numbered minor planets observed were the earth-approaching objects (1685) Toro and (1980) Tezcatlipoca. The Earth approacher 1980 PA was numbered (3908).
Author

N89-15807 Saint Andrew's Univ. (Scotland).
A STUDY OF EARLY-TYPE CLOSE BINARIES Ph.D. Thesis
Steven A. Bell 1987 430 p
Avail: Univ. Microfilms Order NO. BRD-80645

It has become increasingly clear that many binary systems will pass through a common envelope stage at some point during their evolution. For short period systems composed of main-sequence O and early B stars this stage will probably occur for the first time towards the end of hydrogen-core burning in the primary component (case A evolution) rather than during the transition to the giant stage (class B evolution). An observing program was established to study systems of spectral type earlier than B5 and of orbital period of less than 1(sup d).8 in both the Northern and Southern Hemispheres. Light curves were obtained at St. Andrews using the newly-refurbished twin photometric telescope and analyzed using software developed specifically for this instrument. Further spectroscopic and photometric data were obtained at La Palma, SAAO, Sierra Nevada, and Boyden. Analyses of these spectroscopic and photometric observations have provided the necessary physical parameters to determine the evolutionary status of these systems. The systems observed were AH Cephei and V1182 Aquilaw which are shown to be detached systems, TT Aurigae, SX Aurigas, and Al Crucis which are all semi-detached systems and V701 Scorpii, and RZ Pyxidis which are contact systems. Accurately-determined parameters of 14 stars were found, including four O stars in detached systems. The comparison of the physical parameters of 67 stars compiles from this work and from published data with theoretical zero-age and terminal-age main sequences shows that traditional modeling of semi-convection without mass loss is not adequate.
Dissert. Abstr.

N89-15808# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
PHASE-COHERENT ASTROMETRIC INTERFEROMETRY
Annual Report, 1 Feb. 1987 - 31 Jan. 1988
David H. Staelin, J. W. Barrett, Braden E. Hines, and Edward J. Kim 18 Aug. 1988 9 p
(Contract N00014-86-C-2114)
(AD-A199419) Avail: NTIS HC A02/MF A01 CSCL 03A

The principal effort during the second year of this program involved continued development and use of the Mark III stellar interferometer. This is a fringe-tracking long baseline Michelson interferometer designed primarily for wide angle astronomy at the milli-arcsecond level. Initial measurements of stellar diameters were also made, and it will be useful as part of a test bed for concepts relevant to aperture synthesis imaging. It is being constructed on Mount Wilson in California as a joint project involving the Massachusetts Institute of Technology, the Smithsonian Astrophysical Observatory, the Naval Research Laboratory, and the U.S. Naval Observatory. The first successful observations of 1986 were extended during 1987. The two major instrument development efforts this year involve the laser siderostat subsystem and a real-time hardware autocorrelator designed to replace the fringe-tracking subsystem, and to permit operation with dimmer stars.
GRA

N89-15809# Los Alamos National Lab., NM.
OBSERVATIONS OF CLASSICAL NOVAE IN OUTBURST
S. Starrfield, L. L. Stryker, G. Sonneborn, W. M. Sparks, G. Ferland, R. M. Wagner, R. E. Williams, R. D. Gehrz, E. P. Ney, and S. Kenyon 1988 15 p Presented at the Conference on A Decade of UV Astronomy With the IUE Satellite, Washington, DC, 1 Jun. 1988
(Contract W-7405-eng-36)
(DE88-016322; LA-UR-88-2690; CONF-8806226-4) Avail: NTIS HC A03/MF A01

Over the past 10 years the IUE Satellite has obtained ultraviolet data on a number of novae in outbursts and the characteristics of every one of the outbursts have been different. In addition, the group has also obtained optical and infrared data on many of the same novae. Data on three members of the carbon-oxygen class of novae are presented.
DOE

N89-15810*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
FUTURE ASTRONOMICAL OBSERVATORIES ON THE MOON
Jack O. Burns, ed. (New Mexico Univ., Albuquerque.) and Wendell W. Mendell, ed. Washington, DC Mar. 1988 129 p Workshop held in Houston, TX, 10 Jan. 1986; sponsored by NASA, Johnson Space Flight Center, Houston, TX and American Astronomical Society, Washington, DC
(NASA-CP-2489; S-569; NAS 1.55:2489) Avail: NTIS HC A07/MF A01 CSCL 03A

Papers at a workshop which consider the topic astronomical observations from a lunar base are presented. In part 1, the rationale for performing astronomy on the Moon is established and economic factors are considered. Part 2 includes concepts for individual lunar based telescopes at the shortest X-ray and gamma ray wavelengths, for high energy cosmic rays, and at optical and infrared wavelengths. Lunar radio frequency telescopes are considered in part 3, and engineering considerations for lunar base observatories are discussed in part 4. Throughout, advantages and disadvantages of lunar basing compared to terrestrial and orbital basing of observatories are weighted. The participants concluded that the Moon is very possibly the best location within the inner solar system from which to perform front-line astronomical research. For individual titles, see N89-15811 through N89-15827.

N89-15811*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SCIENCE OBJECTIVES IN THE LUNAR BASE ADVOCACY
c91
Wendell W. Mendell *In its* Future Astronomical Observatories

on the Moon Mar. 1988 p 11-12 (For primary document see N89-15810 07-89)
Avail: NTIS HC A07/MF A01 CSCL 03B

The author considers the potential function of astronomy in planning for a lunar base during the 21st century. He is one of the leading advocates for a permanent settlement on the Moon and has given considerable thought to the possible impact of such a station on science. He considers the rationale for a lunar base, research on the Moon, and the definition of science objectives. E.R.

N89-15812*# Los Alamos National Lab., NM.
CAN THE UNITED STATES AFFORD A LUNAR BASE c91
Paul W. Keaton *In* NASA, Lyndon B. Johnson Space Center, Future Astronomical Observatories on the Moon Mar. 1988 p 13-19 (For primary document see N89-15810 07-89)
Avail: NTIS HC A07/MF A01 CSCL 03B

Establishing a lunar base will require steady funding for a decade or two. The question addressed is whether such a large space project is affordable at this time. The relevant facts and methodology are presented so that the reader may formulate independent answers. It is shown that a permanent lunar base can be financed without increasing NASA's historical budgetary trend. Author

N89-15813*# New Mexico Univ., Albuquerque. Dept. of Geology.
GEOLOGICAL CONSIDERATIONS FOR LUNAR TELESCOPES
G. Jeffrey Taylor *In* NASA, Lyndon B. Johnson Space Center, Future Astronomical Observatories on the Moon Mar. 1988 p 21-29 (For primary document see N89-15810 07-89)
Avail: NTIS HC A07/MF A01 CSCL 03A

The geological features of the Moon that may be advantageous for astronomical observations are listed and described. The Moon's geologic environment offers wondrous opportunities for astronomy and presents fascinating challenges for engineers designing telescope facilities on the lunar surface. The geologic nature of the stark lunar surface and the Moon's tenuous atmosphere are summarized. The Moon as a stable platform is described as is its atmosphere, surface temperatures, its magnetic field, its regolith, and its crater morphologies. Author

N89-15814*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CRYOGENIC, POLAR LUNAR OBSERVATORIES c91
J. D. Burke *In* NASA, Lyndon B. Johnson Space Center, Future Astronomical Observatories on the Moon Mar. 1988 p 31-36 (For primary document see N89-15810 07-89)
Avail: NTIS HC A07/MF A01 CSCL 03B

In a geological vein, it is noted that some permanently shadowed regions on the Moon could provide natural passive cooling environments for astronomical detectors. A telescope located in one of the low, dark, polar regions could operate with only passive cooling at 40 K or perhaps lower, depending on how well it could be insulated from the ground and surrounded by radiation shields to block heat and light from any nearby warm or illuminated objects. Author

N89-15815*# McDonald Observatory, Austin, TX.
OVERVIEW OF LUNAR-BASED ASTRONOMY
Harlan J. Smith *In* NASA, Lyndon B. Johnson Space Center, Future Astronomical Observatories on the Moon Mar. 1988 p 37-42 (For primary document see N89-15810 07-89)
Avail: NTIS HC A07/MF A01 CSCL 03A

The opportunities along with the advantages and disadvantages of the Moon for astronomical observatories are carefully and methodically considered. Taking a relatively unbiased approach, it was concluded that lunar observatories will clearly be a major factor in the future of astronomy in the next century. He concludes that ground based work will continue because of its accessibility and that Earth orbital work will remain useful, primarily for convenience of access in constructing and operating very large space systems. Deep space studies will feature not only probes but extensive systems for extremely long baseline studies at wavelengths from gamma rays through visible and IR out to radio is also a conclusion drawn, along with the consideration that lunar astronomy will have found important permanent applications along lines such as are discussed at the present symposium and others quite unsuspected today. E.R.

N89-15816*# Smithsonian Astrophysical Observatory, Cambridge, MA.
HIGH-ENERGY ASTRONOMY FROM A LUNAR BASE
Paul Gorenstein *In* NASA, Lyndon B. Johnson Space Center, Future Astronomical Observatories on the Moon Mar. 1988 p 45-53 (For primary document see N89-15810 07-89)
Avail: NTIS HC A07/MF A01 CSCL 03A

A discussion is presented of the advantages of the Moon for X-ray astronomy. It is concluded that large area detectors connected to long focal length telescopes will provide superior signal to noise ratios and resolution compared to any high energy photon observatories that can be practically placed in Earth orbit. E.R.

N89-15817*# New Mexico Univ., Albuquerque. Dept. of Physics and Astronomy.
COSMIC-RAY DETECTORS ON THE MOON c93
John Linsley *In* NASA, Lyndon B. Johnson Space Center, Future Astronomical Observatories on the Moon Mar. 1988 p 55-62 (For primary document see N89-15810 07-89)
Avail: NTIS HC A07/MF A01 CSCL 03B

The state of cosmic ray physics is reviewed. It is concluded that the nonexistent lunar magnetic field, the low lunar radiation background, and the lack of an atmosphere on the Moon provide an excellent environment for the study of high energy primary cosmic rays. E.R.

N89-15818*# Space Telescope Science Inst., Baltimore, MD.
SPACE AND LUNAR-BASED OPTICAL TELESCOPES
H. S. Stockman *In* NASA, Lyndon B. Johnson Space Center, Future Astronomical Observatories on the Moon Mar. 1988 p 63-71 (For primary document see N89-15810 07-89)
Avail: NTIS HC A07/MF A01 CSCL 03A

The growth of space observatories, especially at optical wavelengths, during the next several decades is considered. It is concluded that large aperture optical telescopes on the Moon, possibly constructed of lunar glasses, will be very competitive with and in some instances superior to Earth orbiting telescopes. E.R.

N89-15819*# Massachusetts Inst. of Tech., Cambridge.
ASTRONOMICAL INTERFEROMETRY ON THE MOON
Bernard F. Burke *In* NASA, Lyndon B. Johnson Space Center, Future Astronomical Observatories on the Moon Mar. 1988 p 73-83 Repr. Lunar Bases and Space Activities of the 21st Century, Lunar and Planetary Inst., Houston, TX, 1985 (For primary document see N89-15810 07-89)
Avail: NTIS HC A07/MF A01 CSCL 03A

Optical interferometric arrays are particularly attractive candidates for a manned lunar base. A permanent lunar can provide support for a variety of astronomical investigations. An optical interferometric array, perhaps of the general form of the VLA but designed for optical instead of radio wavelengths, would lead to a qualitative advance in the understanding of the universe. A wide variety of scientific problems could be addressed by such an instrument. The stellar analogs of the solar cycle, the behavior of sunspots on other stars, the magnetic field configurations of other stars, and the behavior of dynamic plasma phenomena such as flares and winds are examples of star related problems that ultimately would lead to both increased understanding of our Sun and fundamental knowledge of the manner in which stars form and evolve. Author

N89-15820*# McDonald Observatory, Austin, TX.
INFRARED ASTRONOMY FROM THE MOON
Dan Lester *In* NASA, Lyndon B. Johnson Space Center, Future

Astronomical Observatories on the Moon Mar. 1988 p 85-87 (For primary document see N89-15810 07-89)
Avail: NTIS HC A07/MF A01 CSCL 03A

The Moon offers some remarkable opportunities for performing infrared astronomy. Although the transportation overhead can be expected to be very large compared with that for facilities in Earth orbit, certain aspects of the lunar environment should allow significant simplifications in the design of telescopes with background limited performance, at least in some parts of the thermal infrared spectrum. Why leave the Earth to perform infrared astronomy is addressed as is the reasons for going all the way to the Moon for its environment. Author

N89-15821*# California Univ., Santa Cruz.
VERY LARGE ARECIBO-TYPE TELESCOPES Abstract Only
Frank D. Drake *In* NASA, Lyndon B. Johnson Space Center, Future Astronomical Observatories on the Moon Mar. 1988 p 91-92 (For primary document see N89-15810 07-89)
Avail: NTIS HC A07/MF A01 CSCL 03A

The Arecibo-type radio telescope, based on a fixed spherical reflector, is a very effective design for a large radio telescope on the Moon. In such telescopes, major structural members are provided by the ground on which they are built, and thus are provided at no cost in materials or transportation. The strong compression members, the tall towers which support the suspended platform, are an expensive part of the Arecibo telescope. The need for such towers can be eliminated if a suitable valley or crater can be found wherein the rim of the depression can be used as the support point for the cables which support the suspended platform. With an Arecibo-type radio telescope on the Moon, there are no changing gravity loads because of the design and no changing wind ldads because of the location; therefore, the only source of time variation in the telescope geometry is thermal changes. Calculations show that with conventional materials, such as steel, it should be possible to construct an Arecibo-type telescope with a reflector diameter of some 30 km on the Moon, and with a reflector diameter of some 60 to 90 km if materials of high specific strength are used. Author

N89-15822*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
LUNAR RADIO ASTROMETRY
Roger Linfield *In* NASA, Lyndon B. Johnson Space Center, Future Astronomical Observatories on the Moon Mar. 1988 p 93-96 (For primary document see N89-15810 07-89)
Avail: NTIS HC A07/MF A01 CSCL 03A

The accuracy of Earth-based radio astronomy is limited in a fundamental way by the variable delay of the troposphere and by the centimeter-scale motions of a dynamic Earth. Going to Earth orbit solves the variable delay problems, but problems with evolution of the baseline vector remain. The Moon can provide a stable platform where the potential accuracy of radio astromony is one or two orders of magnitude better than from the Earth. Author

N89-15823*# New Mexico Univ., Albuquerque. Inst. for Astrophysics.
MERI: AN ULTRA-LONG-BASELINE MOON-EARTH RADIO INTERFEROMETER **c35**
Jack O. Burns *In* NASA, Lyndon B. Johnson Space Center, Future Astronomical Observatories on the Moon Mar. 1988 p 97-104 Sponsored in part by Los Alamos National Lab. (For primary document see N89-15810 07-89)
Avail: NTIS HC A07/MF A01 CSCL 14B

An extension of the very long baseline technique currently used with ground based telescopes which will produce a resolution of 0.4 micro-arcsec at 300 GHz is described. The MERI array will open an entirely new regime of wavelengths, resolutions, and sensitivities for radio astronomy. As with any such leap in astronomical instrumentation, this advancement will result in the observation of a variety of known radio sources and the exploration of their structures in unprecedented detail. Even so, it may be the serendipitous discoveries, which are by definition impossible to predict, that ultimately justify the construction of MERI. E.R.

N89-15824*# Naval Research Lab., Washington, DC. Center for Space Research.
RADIOWAVE SCATTERING AND ULTRA-LONG-BASELINE INTERFEROMETRY **c32**
Brian Dennison *In* NASA, Lyndon B. Johnson Space Center, Future Astronomical Observatories on the Moon Mar. 1988 p 105-112 (For primary document see N89-15810 07-89)
Avail: NTIS HC A07/MF A01 CSCL 20N

Interstellar scattering can irretrievably blur the images of compact radio sources when examined with extremely high resolution. Because of this effect, diffraction limited observations of extragalactic sources with an Earth-Moon baseline will only be possible at frequencies above about 7 GHz, in which case the resolution will be approx. = to or less than 20 microarcsec. Preliminary observations to determine the potential usefulness of such resolving power are discussed. The simplest of these would consist of a search for interstellar scintillations in compact sources at 10 GHz, which would provide an effective resolution about equal to that of an Earth-Moon baseline at this frequency. Also important in this context is the development of very long baseline interferometry in near-Earth orbit, as any ultra high resolution observations, if appropriate, would require intermediate baselines for mapping. Author

N89-15825*# Texas Univ., Austin. Dept. of Astronomy.
A VERY LOW FREQUENCY RADIO ASTRONOMY OBSERVATORY ON THE MOON
James N. Douglas and Harlan J. Smith *In* NASA, Lyndon B. Johnson Space Center, Future Astronomical Observatories on the Moon Mar. 1988 p 113-118 Repr. from Lunar Bases and Space Activities of the 21st Century, Lunar and Planetary Institute, Houston, TX (For primary document see N89-15810 07-89)
Avail: NTIS HC A07/MF A01 CSCL 03A

Because of terrestrial ionospheric absorption, very little is known of the radio sky beyond 10 m wavelength. An extremely simple, low cost very low frequency radio telescope is proposed, consisting of a large array of short wires laid on the lunar surface, each wire equipped with an amplifier and a digitizer, and connected to a common computer. The telescope could do simultaneous multifrequency observations of much of the visible sky with high resolution in the 10 to 100 m wavelength range, and with lower resolution in the 100 to 1000 m range. It would explore structure and spectra of galactic and extragalactic point sources, objects, and clouds, and would produce detailed quasi-three-dimensional mapping of interstellar matter within several thousand parsecs of the Sun. Author

N89-15826*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
A LUNAR BASE FOR SETI (SEARCH FOR EXTRATERRESTRIAL INTELLIGENCE) **c55**
Bernard M. Oliver *In* NASA, Lyndon B. Johnson Space Center, Future Astronomical Observatories on the Moon Mar. 1988 p 119-123 (For primary document see N89-15810 07-89)
Avail: NTIS HC A07/MF A01 CSCL 06C

The possibilities of using lanar based radio antennas in search of intelligent extraterrestrial communications is explored. The proposed NASA search will have two search modes: (1) An all sky survey covering the frequency range from 1 to 10 GHz; and (2) A high sensitivity targeted search listening for signals from the approx. 800 solar type stars within 80 light years of the Sun, and covering 1 to 3 GHz. Author

N89-15827*# BDM Corp., Albuquerque, NM.
DESIGN OF LUNAR BASE OBSERVATORIES
Stewart W. Johnson *In* NASA, Lyndon B. Johnson Space Center, Future Astronomical Observatories on the Moon Mar. 1988 p 127-134 (For primary document see N89-15810 07-89)
Avail: NTIS HC A07/MF A01 CSCL 03A

Several recently suggested concepts for conducting astronomy

from a lunar base are cited. Then, the process and sequence of events that will be required to design an observatory to be emplaced on the Moon are examined. Author

N89-15828# National Academy of Sciences - National Research Council, Washington, DC. Task Group on Astronomy and Astrophysics.
SPACE SCIENCE IN THE TWENTY-FIRST CENTURY: IMPERATIVES FOR THE DECADES 1995 TO 2015: ASTRONOMY AND ASTROPHYSICS
1988 84 p
(LC-87-43333; ISBN-0-309-03875-8) Avail: NTIS HC A05/MF A01

The program of new initiatives for the era 1995 to 2015 focuses on improvements in capabilities in two areas: higher angular resolution and greater collecting areas. The expected 1995 status is outlined for radio astronomy, infrared and submillimeter astronomy, ultraviolet and optical wavelengths, X-ray astronomy, gamma-ray astronomy, cosmic-ray astronomy, astrophysics, gravitational physics, NASA operational status, and international programs. New initiatives and practical considerations (budgetary requirements, international cooperation, cost-to-weight ratio, management, facilities, and instrumentation) are reviewed.
Author

N89-15829*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
IUE ARCHIVED SPECTRA
Edward C. Sullivan, Ralph C. Bohlin, Sara R. Heap, Donald K. West, and Marion Schmitz (Computer Sciences Corp., Silver Spring, MD.) Jun. 1988 25 p
(NASA-TM-100715; Rept-89B0037; NAS 1.15:100715) Avail: NTIS HC A03/MF A01 CSCL 03A

The International Ultraviolet Explorer (IUE) Satellite has been in continuous operation since January 26, 1978. To date, approximately 65,000 spectra have been stored in an archive at Goddard Space Flight Center in Greenbelt, MD. A number of procedures have been generated to facilitate access to the data in the IUE spectral archive. This document describes the procedures which include on-line quick look of the displays, search of an observation data base for selected observations, and several methods for ordering data from the archive. Author

90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics*.

N89-15830 Oxford Univ. (England).
TWO PROBLEMS RELATING TO COSMIC CENSORSHIP Ph.D. Thesis
T. R. A. Needham 1986 83 p
Avail: Univ. Microfilms Order No. BRD-81502

In the First Problem one unambiguous prediction of cosmic censorship is put to test, namely that it should be impossible to destroy a black hole (i.e., eliminate its horizon) by injecting test particles into it. It is shown that if a general charged spinning particle is injected in an arbitrary manner into an extreme Kerr-Newman black hole, then cosmic censorship is upheld. Also considered was the injection of particles with parameters that are not small compared with those of the hole, for which cosmic censorship is apparently violated. The assumption of the validity of cosmic censorship leads to a few conjectures concerning the extent of the particle's interaction with the hole while approaching it. The Second Problem is an investigation of a conjecture by W. Israel. It states, in essence, that collapsing stars will generically form black holes even though naked singularities may also be produced. More precisely, it is conjectured that if a trapped surface forms during a collapse then it can be extended toward the future into a spacelike 3-cylinder omega whose sections are trapped surfaces having dimensions which remain bounded above and below. The interior of omega would then be causally incarcerated. The nature and the role of the conjecture are discussed. An intuitive picture of an evolving spinning black hole is used to find a plausible method of generating omega from a trapped surface.
Dissert. Abstr.

N89-15831 Oxford Univ. (England).
MASS FLOW IN BINARY STARS Ph.D. Thesis
Robert Whitehurst 1987 271 p
Avail: Univ. Microfilms Order No. BRD-81521

The problem of mass flow between the members of cataclysmic variable stars is addressed with particular emphasis to the U Geminorum and SU Ursae Majoris classes of dwarf novae. A new, two dimensional particle based numerical simulation of the kinematics of this gas flow was developed. This is used to determine constraints on the postulated mechanisms for dwarf nova eruptions. The observed outbursts were found inconsistent with the simple, constant viscosity mass transfer models which have been published to date. Instead the results suggests that the disc switches from a state of high viscosity in outburst to low viscosity in quiescence, as proposed by disc instability models. The tidal forces imposed by the companion stars upon the accretion flow are discovered to be important; with two classes of possible disc behavior in outbursts: a tidally stable disc and a tidally unstable disc. The tidally stable disc exists in those systems where the primary is less than four times as massive as the secondary; the unstable disc occurs in outbursts of systems with more extreme mass ratios. This division corresponds to the observed distinction between the SU Ursae Majoris and U Geminorum classes of dwarf novae. Dissert. Abstr.

N89-15832 Harvard Univ., Cambridge, MA.
X-RAY AND ULTRAVIOLET STUDIES OF THE INTERSTELLAR MEDIUM AND THE WINDS OF CATACLYSMIC VARIABLES Ph.D. Thesis
Christopher Wayne Mauche 1987 329 p
Avail: Univ. Microfilms Order No. DA8806108

By means of an analysis of X-ray imaging data obtained with the Einstein Observatory, a study of the halos of Galactic X-ray sources, produced by the scattering of X-rays by intersetellar grains is presented. The size, shape, and intensity of these X-ray halos are used to determine the parameters characterizing interstellar grains. In addition, an observational study is presented of the X-ray halos of the four brightest young Galactic supernova remnants: the Crab Nebula, Cas A, Tycho's and Kepler's supernova remnant; an observational and theoretical study of the purported soft X-ray halo around the dwarf nova SU UMa; and a theoretical study of the modulation of this source's X-ray light curve and the impact of this effect on the stellar wind, cocoon, and accretion disk corona models for this source. In addition, by means of an analysis of the narrow absorption lines in high-resolution ultraviolet spectra obtained with the International Ultraviolet Explorer (IUE), a study is presented of the properties characterizing the gas phase of the interstellar medium in the vicinity of the Sun toward five cataclysmic variables: SS Cyg, V3885 Sgr, IX Vel, RW Sex, and AM Her. In addition to the absorption lines of the neutral and singly ionized species in the neutral interstellar gas along the line of sight to these cataclysmic variables, narrow velocity-shifted absorption lines were identified for C IV, S IV, and Si III in the spectrum of SS Cyg, and thereby infer the existence of an expanding H II region of interstellar gas ionized by the EUV and soft X-ray flux of this cataclysmic variable. Dissert. Abstr.

N89-15833 Maryland Univ., College Park.
THE GALACTIC PLANE AT 30.9 MHz Ph.D. Thesis
Namir El Sheikh Kassim 1987 251 p
Avail: Univ. Microfilms Order No. DA8808566

The Galactic plane was mapped with the Clark Lake TPT telescope at a frequency of 30.9 MHz with unprecedented resolution. The synthesized beam is 13.0' x 11.1' at the zenith. Contour maps were produced. A source list is presented which contains integrated flux densities and positions for 696 discrete emission features. More than 60 of these are likely to be previously

unidentified Galactic supernova remnants (SNRs). Accurate spectra for 36 known Galactic SNRs were constructed and many show low frequency turnovers due to free-free absorption by intervening ionized gas. Numerous HII regions were detected in absorption against the Galactic nonthermal background. A line of sight emissivity towards the giant HII region W51 of 2.3 K/pc at 30.9 MHz was calculated based upon an assumed distance of 6.5 kpc. Galactic foreground and background temperatures of 39,300 K and 14,800 K, respectively, were also determined. Source counts in the outer Galaxy indicate 2.1 x 1000 sources per steradian with flux densities greater than 4 Jy at 30.9 MHz. This agrees with the extrapolation of extragalactic source counts at 408 MHz. Dissert. Abstr.

N89-15834 Massachusetts Univ., Amherst.
THE ROLE OF MOLECULAR CLOUDS IN THE STAR FORMATION PROCESS AS OBSERVED IN TWO GRAND DESIGN SPIRAL GALAXIES Ph.D. Thesis
Steven Donald Lord 1987 244 p
Avail: Univ. Microfilms Order No. DA8805949

The molecular, neutral, and ionized hydrogen distributions were compared in two nearly spiral galaxies. To estimate H2 surface densities, o observations were acquired for the CO (J = 1 yields 0) transition in 60 positions to a radius of 135 seconds in the Sbc galaxy M51 (NGC 5194), and in 21 positions to a radius of 150 seconds in the SAB galaxy M83 (NGC 5236) using the 13.7 m telescope of the Five College Radio Astronomy Observatory. The molecular component of the ISM was found to strongly dominate over the HI component in each galaxy. Extinction corrected H alpha intensities were used to compute the detailed masssive star formation rates (MSFRs) in each galaxy. Estimates of the MSFR, gas density, and the ratio of these quantiaties, the massive star formation efficiency (MSFE) were then examined. Dissert. Abstr.

N89-15835 Washington Univ., Seattle.
BLACK-HOLE NORMAL MODES: A WKB APPROACH Ph.D. Thesis
Sai Kothandaram Iyer 1987 80 p
Avail: Univ. Microfilms Order No. DA8812759

The normal modes of black-hole oscillations were studied. These are resonant modes characterized by a spectrum of discrete, complex frequencies. A semi-analytic technique is presented for determining the complex normal-mode frequencies. The method makes use of the WKB approximation, carried to the third order beyond the eikonal approximation. Mathematically, the problem is similar to studying one-dimensional quantum mechanical scattering near the peak of a potential barrier, and determining the scattering resonances. Under such conditions, a modification of the usual WKB approach must be used. The connection formulae that relate the amplitudes of incident, reflected and transmitted waves, to the third WKB order are obtained. By imposing the normal-mode (resonance) boundary condition of zero incident amplitude with non-zero transmitted and reflected amplitudes, a simple formula was found that determines the real and imaginary parts of the normal-mode frequency of the perturbation (or of the quantum mechanical energy of the resonance) in terms of the derivatives (up to and including the sixth order) of the barrier function evaluated at the peak, and in terms of the quantity (n + 1/2), where n is an integer and labels the fundamental mode (resonance), first overtone, and so on. This approach was applied to the Schwarzschild, Kerr, and Reissner-Nordstrom black holes, with results in excellent agreement with existing numerical results for the fundamental and low lying modes. Dissert. Abstr.

N89-15836# Los Alamos National Lab., NM.
NUCLEAR ASTROPHYSICS FROM NEUTRON CROSS-SECTION MEASUREMENTS ON RADIACTIVE SAMPLES
P. E. Koehler and H. A. OBrien 1988 15 p Presented at the International Conference on the Application of Accelerators in Research and Industry, Denton, TX, 7 Nov. 1988
(Contract W-7405-eng-36)
(DE89-000316; LA-UR-88-3177; CONF-881151-3) Avail: NTIS HC A03/MF A01

Reaction rates for both big-bang and stellar nucleosynthesis calculations can be obtained from the measurement of (n,p) (n,alpha) and (n,gamma) cross sections for radioactive nuclei. In the past, large backgrounds associated with the sample activity limited these types of measurements to radioisotopes with very long half lives. The advent of the high-intensity neutron source at the Los Alamos Neutron Scattering Center (LANSCE) has greatly increased the number of nuclei which can be studied. Results of recent measurements on samples with half lives as short as fifty-three days are given. Plans for future measurements are discussed. DOE

N89-15837# Los Alamos National Lab., NM.
SOLAR-LIKE OSCILLATIONS IN LATE SPECTRAL CLASS STARS
Arthur N. Cox and J. H. Cahn 1988 6 p Presented at the Symposium on the Seismology of the Sun and Sun-Like Stars, Puerto de la Cruz, Spain, 26 Sep. 1988
(Contract W-7405-eng-36)
(DE89-000321; LA-UR-88-3219; CONF-8809146-2) Avail: NTIS HC A02/MF A01

We investigate the minimum mass star that can exhibit solar-like nonradial p-mode oscillations. Solar models have almost equal pulsational driving and damping due to standard radiative effects. Coupling with surface convective elements occasionally tips the balance by strongly driving for a few days modes with convection timescales at the top of the convection zone. Then both convective and radiative damping decrease the mode amplitude at an observed decay rate, until the next convective reexcitation. Population I stellar models at 0.30, 0.45, and 0.75 Msub solar have been constructed to see if they have a near equality of radiative driving and damping also. If so, then stars down to late spectral class could possibly display solar-like oscillations. We find that the near equality of radiative driving and damping occurs down to about 0.5sub solar. Possibly 100 to 300 second oscillations can be observed through most of the K spectral class, if magnetic activity does not overwhelm these small amplitude nonradial pulsations. DOE

N89-15838# Los Alamos National Lab., NM. Space Plasma Physics Group.
THREE-DIMENSIONAL PLASMA MEASUREMENTS FROM THREE-AXIS STABILIZED SPACECRAFT
S. J. Bame, R. H. Martin, D. J. McComas, J. L. Burch, J. A. Marshall, and D. T. Young (Southwest Research Inst., San Antonio, TX.) 1988 36 p Presented at the Yosemite Conference on Outstanding Problems in Solar System Plasma Physics: Theory and Instrumentation, Yosemite, CA, 2 Feb. 1988
(Contract W-7405-eng-36)
(DE89-000361; LA-UR-88-3145; CONF-8802110-1) Avail: NTIS HC A03/MF A01

Future planetary missions require that comprehensive three-dimensional measurements of electrons and mass-resolved ions be made from three-axis stabilized spacecraft. In order to make these measurements without requiring expensive and resource intensive platforms to scan space mechanically, we are developing various systems that are designed to scan space electrostatically. These systems also make it possible to circumvent the significant shadowing that would be present even with a scan platform, caused by necessary spacecraft appendages such as communications antennas and a power source (RTG or solar cell panels). The systems, which are axially symmetric, select particles arriving from 360 degrees in azimuth along conical surfaces whose polar (or elevation) angles, referenced to the instrument symmetry axes, are determined by applying suitable deflection voltages to shapes deflectors. Particles thus selected in polar angle pass into spherically or toroidally-shaped electrostatic analyzers. After analysis, the 360 degree outputs of the analyzers are divided into discrete angular swaths to provide azimuthal angle resolution. DOE

N89-15839# Lawrence Livermore National Lab., CA.
RADIOACTIVE BEAM STUDIES OF COSMOLOGICAL INTEREST
K. E. Sale, R. N. Boyd, G. J. Mathews, P. B. Corn, and M. S. Islam (Ohio State Univ., Columbus.) 23 Sep. 1988 5 p Presented at the International Conference on the Application of Accelerators in Research and Industry, Denton, TX, 7 Nov. 1988
(Contract W-7405-eng-48)
(DE89-001129; UCRL-98965; CONF-881151-12) Avail: NTIS HC A02/MF A01

Experimental efforts by the Lawrence Livermore National Laboratories/Ohio State radioactive ion beam collaboration are described. We are presently focusing on some reactions which are of great importance in the newly proposed inhomogeneous big bang cosmological models. Specifically we are using our system to make beams of (8)Li for measurements of the (8)Li(d,n) (9)Be and (8)Be and (8)Li(alpha,n) (11) B cross sections. These are the key reactions which determine the production of heavy (A greater than 12) elements during the era of big bang nucleosynthesis, and thus the initial composition of stars and subsequent stellar isotope production. Plans for future experiments, including the measurement of the (7)Be(p,gamma) (8)B cross section will be discussed. DOE

N89-15840*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
OBSERVATIONS AND SIMULATIONS OF RECURRENT NOVAE: U Sco AND V394 CrA
S. Starrfield, G. Sonneborn, W. M. Sparks, G. Shaviv, R. E. Williams, S. Heathcote, G. Ferland, R. D. Gehrz, E. P. Ney, and S. Kenyon (Harvard Univ., Cambridge, MA.) 1988 10 p Presented at the Conference on A Decade of UV Astronomy With the IUE Satellite, Washington, DC, 1 Jun. 1988 Prepared in cooperation with Los Alamos National Lab., NM Sponsored in part by NSF and DOE
(Contracts NAS5-28731; W-7405-eng-36)
(NASA-CR-184629; NAS 1.26:184629; DE88-016323; LA-UR-88-2689; CONF-8806226-3) Avail: NTIS HC A03/MF A01 CSCL 03B

We present observations and analysis of the August 1987 outburst of the recurrent nova V394 CrA. This nova was extremely fast and its outburst characteristics closely resembled those of the Recurrent Nova U Sco. In addition to the observations, we have performed hydrodynamic simulations of the outbursts of recurrent novae and present a summary of these results as applied to the outbursts of V394 CrA and U Sco. DOE

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

N89-15841 California Univ., Los Angeles.
TIDAL DISSIPATION, THERMAL AND DYNAMIC EVOLUTION AND INTERNAL STRUCTURE OF SEVERAL OUTER PLANET SATELLITES, MERCURY AND THE EARTH-MOON SYSTEM Ph.D. Thesis
Martin Nicholas Ross 1988 283 p
Avail: Univ. Microfilms Order No. DA8810219

The thermal and dynamic effects of tidal dissipation in realistic models of Io, Europa, Enceladus, Mercury, the Earth and Moon are studied. The coupling between temperature and dissipation is included using temperature dependent dissipation. The secular shapes of synchronously rotating satellites are investigated to deduce internal structure. In the deep-mantle model Io model, tidal heating occurs at the core mantle boundary beneath the polar regions. In the asthenosphere Io model, tidal heating occurs in a thin fluid layer beneath the outer elastic shell. The Love number of an internal water ocean model of Europa equals about 0.26; tidal heating in the model is much less than previously thought. Models of Enceladus posses a thermally active interior and plausible long term surface activity. Tidal heating occurs in a mantle beneath a lithosphere about 10 km thick. Detailed models of Mercury's thermal evolution include a growing inner core, a thickening lithosphere, and tidal heating. The thermal and dynamic evolution of the Earth and Moon are studied with temperature dependent dissipation. The time dependent behavior of lunar orbit elements, mantle temperatures, and tidal phase lags are calculated. Dissert. Abstr.

N89-15842 Baylor Univ., Waco, TX.
A COMPREHENSIVE INVESTIGATION USING THE MIE SCATTERING THEORY OF MICRON AND SUBMICRON LUNAR EJECTA DYNAMICS IN SELENOCENTRIC, CISLUNAR AND GEOCENTRIC SPACE Ph.D. Thesis
Truell Wayne Hyde, II 1988 178 p
Avail: Univ. Microfilms Order No. DA8811283

The complete set of forces acting on a particle traveling in selenocentric, cislunar, and geocentric space are studied. Force tables are calculated and presented using varying particle size and densities as well as two particle potential. The radiation pressure force is treated independently under a geometric, Raleigh, and the full Mie scattering theory approximation. Comparisons of the beta values under all of the above are calculated and analyzed. A computer model which calculates and categories orbits for particles originating on the lunar surface and traveling in selenocentric, cislunar, and geocentric space is presented. The results using the data from over 1.9 million individual orbits calculated under varying initial conditions for the earth, moon, and particle are given. The radiation pressure force term in the above mentioned computer model is again calcualted under all the approximations listed previously. A correlation between the particle's complex index of refraction and its probability of intersection with the EMPs is shown. Evidence is presented to show that particles with radii below 0.1 microns can indeed attain a near-earth orbit under the proper conditions. A method whereby the origin of particles in the near-earth orbit can be determined is discussed. Dissert. Abstr.

N89-15843*# Georgia Inst. of Tech., Atlanta. School of Electrical Engineering.
LABORATORY EVALUATION AND APPLICATION OF MICROWAVE ABSORPTION PROPERTIES UNDER SIMULATED CONDITIONS FOR PLANETARY ATMOSPHERES Semiannual Status Report No. 10, 1 Feb. 1988 - 31 Jan. 1989
Paul G. Steffes 1988 43 p
(Grant NAGw-533)
(NASA-CR-183327; NAS 1.26:183327) Avail: NTIS HC A03/MF A01 CSCL 03B

Radio absorptivity data for planetary atmospheres obtained from spacecraft radio occultation experiments and earth-based radio astronomical observations can be used to infer abundances of microwave absorbing atmospheric constituents in those atmospheres, as long as reliable information regarding the microwave absorbing properties of potential constituents is available. The key activity for this grant year has continued to be laboratory measurements of the microwave and millimeter-wave properties of the simulated atmospheres of the outer planets and their satellites. A Fabry-Perot spectrometer system capable of operation from 32 to 41 GHz was developed. Initially this spectrometer was used to complete laboratory measurements of the 7.5 to 9.3 mm absorption spectrum of ammonia. Laboratory measurements were begun at wavelengths near 3.2 mm, where a large number of observations of the emission from the outer planets were made. A description of this system is presented. B.G.

N89-15844*# Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric and Planetary Sciences.
PART 1: ASPECTS OF LITHOSPHERIC EVOLUTION ON VENUS. PART 2: THERMAL AND COLLISIONAL HISTORIES OF CHONDRITE PARENT BODIES Ph.D. Thesis
Robert E. Grimm Oct. 1988 329 p Sponsored in part by NSF, Washington, D.C.

(Grant NsG-7297)
(NASA-CR-184588; NAS 1.26:184588) Avail: NTIS HC A15/MF A01 CSCL 03B

The geological evolution of distinctly different kinds of solar system objects is addressed. Venus has been observed over the past decade by orbital radars on both American and Soviet spacecraft. These surface measurements provide clues to the structure and evolution of the lithosphere. The parent bodies of chondritic meteorites, thought to resemble asteroids, represent the other end of the size spectrum of terrestrial objects. Their early thermal and collisional histories may be constrained by the chemical and textural record preserved in meteorite samples. Impact craters on Venus have been observed by the Soviet Venera 15/16 spacecraft. A formalism is presented by which the size-frequency distribution of impact craters may be used to estimate upper bounds on the mean global rates of volcanic resurfacing and lithospheric recycling on that planet over the past several hundred million years. The impact crater density reported from Venera observations, if valid, for the entire Venus surface, indicates a mean volcanic flux no greater than 2 cu km/y, corresponding to a maximum average rate of resurfacing of about 4 km/b.y. For the lowest estimated mean crater retention age of the surface of Venus imaged by Venera 15/16, the rate of lithospheric recycling on Venus does not exceed 1.5 sq km/y. Ordinary chondrite meteorites show textural and chemical patterns indicative of varying intensities of thermal metamorphism. The conventional onion-shell model, which envisions highly metamorphosed material in the core and less intensely heated rocks near the surface, predicts an inverse relation between peak temperature and cooking rate, but none has been observed. A metamorphosed-planetesimal model is devised to explain this discrepancy, whereby heating occurs in planetesimals a few kilometers in radius which then accrete to form 100-km-radius parent bodies. Cooling rates are then randomly controlled by burial depth. Thermal and collisional constraints are examined, and the model is found to be applicable only to highly insulating Al-26-rich planetesimals that remain closely aggregated upon accretion. An alternative model is presented, in which onion-shell parent bodies are collisionally fragmented during metamorphism and then gravitationally reassembled. If reassembly times are short, then cooling rates would be determined by burial depth in the reaccreted parent body. This model, unlike previous ones, can explain both coherent and incoherent cooling of Breccia clasts by collisions during or after metamorphism, respectively. Author

N89-15845*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
OEXP EXPLORATION STUDIES TECHNICAL REPORT. VOLUME 3: SPECIAL REPORTS, STUDIES, AND INDEPTH SYSTEMS ASSESSMENTS
Barney B. Roberts and Dan Bland Dec. 1988 1761 p
(NASA-TM-4075-Vol-3; NAS 1.15:4075-Vol-3) Avail: NTIS HC A99/MF E08 CSCL 03B

The Office of Exploration (OEXP) at NASA has been tasked with defining and recommending alternatives for an early 1990's national decision on a focused program of manned exploration of the Solar System. The Mission analysis and System Engineering (MASE) group, which is managed by the Exploration Studies Office at the Johnson Space Center, is responsible for coordinating the technical studies necessary for accomplishing such a task. This technical report, produced by the MASE, describes the process used to conduct exploration studies and discusses the mission developed in a case study approach. The four case studies developed in FY88 include: (1) a manned expedition to PHOBOS; (2) a manned expedition to MARS; (3) a lunar surface observatory; and a lunar outpost to early Mars evolution. The final outcome of this effort is a set of programmatic and technical conclusions and recommendations for the following year's work. Author

N89-15846# National Academy of Sciences - National Research Council, Washington, DC. Task Group on Planetary and Lunar Exploration.
SPACE SCIENCE IN THE TWENTY-FIRST CENTURY: IMPERATIVES FOR THE DECADES 1995 TO 2015. PLANETARY AND LUNAR EXPLORATION
1988 123 p
(LC-87-43335; ISBN-0-309-03885-5) Avail: NTIS HC A06/MF A01

In the next 30 years an increase in the technical infrastructure in space should be seen. This increase should include both earth-orbital facilities for scientific investigations, and advanced capabilities for deep-space operation of scientific spacecraft. The goals of planetary exploration are achieved primarily through spacecraft missions, although various earth-based and orbital activities also serve an integral role. The recommended goals consist of completion of the reconnaissance and exploration of the solar system and intensive exploration of the planet Mars. Accomplishments of the solar system exploration from 1965 to 1995 and the expected scientific questions as of the end of that period are summarized. The program of missions for the period 1995 to 2015 are presented. Author

N89-15847*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
FAST O(SUP +) ION FLOW OBSERVED AROUND VENUS AT LOW ALTITUDES
W. T. Kasprzak and H. B. Niemann Dec. 1988 42 p
(NASA-TM-100717; Rept-89B0053; NAS 1.15:100717) Avail: NTIS HC A03/MF A01 CSCL 03B

The Pioneer Venus Orbiter Neutral Mass Spectrometer (ONMS) has observed fast O(+) ions with an energy exceeding 40 eV in the spacecraft reference frame. The orbit of the spacecraft is nearly polar with periapsis near the equator. The ONMS is mounted at an angle to the spin axis which, in turn, is perpendicular to the ecliptic plane. From the spin modulated data the direction of the ion flow in that plane can be determined. Data from the first 11 diurnal cycles (orbits 1 to 2475) are vector averaged in order to display the general flow pattern. Plots of the averaged data are presented. On the dayside and near the terminators, where fast O(+) is observed near the ionopause, the directions are more or less parallel to the planet's surface with evidence of an asymmetry about the Sun-Venus line. On the nightside below 2000 km and near the equator there is a preferred dawn to dusk direction while at higher altitudes (lower solar zenith angles and higher latitudes) the flow direction is more antisunward. The averaged flux for this time period is 8x10 to the 5th/sq cm/s with a maximum of 5x10 to the 8th. Author

N89-15811*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SCIENCE OBJECTIVES IN THE LUNAR BASE ADVOCACY
Wendell W. Mendell *In its* Future Astronomical Observatories on the Moon Mar. 1988 p 11-12 (For primary document see N89-15810 07-89)
Avail: NTIS HC A07/MF A01 CSCL 03B

N89-15812*# Los Alamos National Lab., NM.
CAN THE UNITED STATES AFFORD A LUNAR BASE
Paul W. Keaton *In* NASA, Lyndon B. Johnson Space Center, Future Astronomical Observatories on the Moon Mar. 1988 p 13-19 (For primary document see N89-15810 07-89)
Avail: NTIS HC A07/MF A01 CSCL 03B

N89-15814*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CRYOGENIC, POLAR LUNAR OBSERVATORIES
J. D. Burke *In* NASA, Lyndon B. Johnson Space Center, Future Astronomical Observatories on the Moon Mar. 1988 p 31-36 (For primary document see N89-15810 07-89)
Avail: NTIS HC A07/MF A01 CSCL 03B

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

For related information see *93 Space Radiation.*

N89-15848 Colorado Univ., Boulder.
SEISMIC PROBING OF SOLAR FLOWS USING HIGH-DEGREE OSCILLATIONS Ph.D. Thesis
Deborah Ann Haber 1987 220 p
Avail: Univ. Microfilms Order No. DA8808278

Employing solar oscillation modes of degree 50 is less than or approximate to l is less than or approximate to 850, the equatorial rotation rate is estimated with depth, searched for possible anisotropies in power for modes traveling in different directions, and examined for the influence of a major flare on the oscillations. Motivated by the need in studying solar rotation for accurate frequency splittings between individual modes, different spatial filtering methods were evaluated to determine which yield the most accurate frequencies. A filtering method based on spherical harmonic projection of the data is found to be superior in this regard. The various filtering techniques are applied to three days of concatenated Doppler velocity data taken on a long, narrow grid centered on the solar disk. An inversion procedure was then performed to determine the equatorial solar rotation in the upper convection zone. Power in sectoral modes traveling along the equator is compared to that in poleward tranveling sectoral modes. Full-disk Doppler velocities observed before and after a major white-light flare are compared to detect any influence of the flare on the 5 minute oscillations. Dissert. Abstr.

N89-15849 California Inst. of Tech., Pasadena.
EXCITATION AND DAMPJNG OF SOLAR p-MODES Ph.D. Thesis
Pawan Kumar 1988 168 p
Avail: Univ. Microfilms Order No. DA8812017

A detailed analysis was carried out of the interaction of acoustic radiation with homogeneous turbulence in order to understand the excitation of solar p-modes by turbulent convection. The most significant outcome is the finding that, for certain types of forced turbulences, the absorption of acoustic waves is no greater than a free turbulence, whereas the emission is always enhanced by a factor M sup -2, where M is the Mach number of the turbulence. Turbulent convection in the sun is an example of this kind of turbulence. This leads to the conclusion that energies in solar p-modes, due to their interaction with the convection, should be approx. = to the thermal energy in a resonant eddy. This is found to be in good agreement with the observations. To resolve the overstability question of solar p-modes, the effectiveness of 3-mode couplings was studied, the most plausible process for limiting the amplitudes of overstable modes. The 3-mode coupling mechanism is also a good candidate for exciting fundamental modes which are found to be linearly stable, but are observed to have energies comparable to p-modes of similar frequencies. The issue of mode stability remains inconclusive. Dissert. Abstr.

N89-15850# Los Alamos National Lab., NM.
OSCILLATION FREQUENCIES OF SOLAR MODELS
Arthur N. Cox, Joyce A. Guzik, and Russell B. Kidman 1988 6 p Presented at the Symposium on the Seismology of the Sun and Sun-Like Stars, Puerto de la Cruz, Spain, 28 Sep. - 1 Oct. 1988 Prepared in cooperation with Iowa State Univ. of Science and Technology, Ames
(Contract W-7405-eng-36)
(DE89-000308; LA-UR-88-3271; CONF-8809146-1) Avail: NTIS HC A02/MF A01

Two solar models have been constructed, one with no diffusion of the atomic nuclei, and another including diffusive element separation. The opacity at the bottom of the convection zone was increased 15 to 20 percent (within its theoretical uncertainty) to obtain a few microhertz agreement with observed p-mode frequencies. Original helium mass fractions were 0.291 and 0.289 for the no-diffusion and diffusion models, respectively. The diffusion model evolved to a surface Y = 0.256 at the solar age, and the original Z value of 0.0200 decreased to 0.0179. Agreement of l = 0 and 2 p-mode frequency separations with those observed is good. The g-mode nonadiabatic solutions do not have equal period spacing until high radial order. The lowest order modes are more visible if they all have the same kinetic energy. High central temperatures, produce over 9 SNUs from the B and 1.5 SNUs from the Be reactions. Models with iron condensed-out below the convection zone, and with WIMPs cooling the central regions to reduce the SNUs, agree less well with p-mode frequency separations. DOE

N89-15851# Consiglio Nazionale delle Ricerche, Frascati (Italy). Istituto di Fisica dello Spazio Interplanetario.
ON THE GEOMAGNETIC RESPONSE TO HIGH SPEED SOLAR WIND STREAMS
O. Borello Filisetti, G. Lovera, V. Mussino, M. Parisi, and M. Storini (La Sapienza Univ., Rome, Italy) Oct. 1987 29 p
(IFSI-87-14; ETN-89-93461) Avail: NTIS HC A03/MF A01

Sixty high speed solar wind streams coming from coronal holes are analyzed grouping the events in three classes according to their time duration. For each class the average 24 hr profile of the interplanetary parameters (magnetic field magnitude B, solar wind bulk speed V, proton density Np, temperature Tp, total pressure P = Np KTp + B2/8 micron and dynamic pressure Pd = mpNpV2) and the geomagnetic indices are obtained. The statistical reliability of these signals is evaluated by means of the two-way analysis of variance; the general features of these signals are discussed. During these streams the time dependence of the geomagnetic index values on a single interplanetary parameter shows an hysteresis-like behavior. It is shown that a single interplanetary parameter is not sufficient to predict the complete geomagnetic perturbation and a combination of at least two variables is necessary. ESA

N89-15852*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
SOLAR WIND OBSERVATIONS WITH THE ION COMPOSITION INSTRUMENT ABOARD THE ISEE-3 ICE SPACECRAFT
K. W. Ogilvie, M. A. Coplan, mi915766, P. Bochsler (Bern Univ., Switzerland), and J. Geiss [1989] 54 p
(Grant NAG5-579)
(NASA-TM-101252; NAS 1.15:101252) Avail: NTIS HC A04/MF A01 CSCL 03B

The principal observations obtained by the Ion Composition Instrument (ICI) flown on the ISEE-3/ICE spacecraft, which was in the solar wind from September 1978 to the end of 1982, before being directed to the far magnetotail of the Earth are discussed. Almost continuous observations were made of the abundances of 3He++, 4He++, O6+, O7+, Ne, Si and Fe in various charge states, and of their bulk speeds and temperatures. The results show that there is a strong tendency in the collisionless solar wind for the ionic temperatures to be proportional to the masses. For heavier ions these temperatures exceed typical coronal electron temperatures. 4He++, especially in high speed streams, moves faster than H+, and travels at the same speed as heavier ions. The mechanism leading to this heating and rapid streaming is still not entirely clear. Author

N89-15853# National Academy of Sciences - National Research Council, Washington, DC. Task Group on Solar and Space Physics.
SPACE SCIENCE IN THE TWENTY-FIRST CENTURY: IMPERATIVES FOR THE DECADES 1995 TO 2015. SOLAR AND SPACE PHYSICS
1988 151 p
(LC-87-43332; ISBN-0-309-03848-0) Avail: NTIS HC A08/MF A01

The purpose is to develop an overall program of space research that will address the most significant topics in the solar and space physics discipline, that will clearly define the priority of investigations, and that will be affordable by NASA. The status of solar and space physics expected in 1995, assuming a number of space programs proceed according to present plans, is described.

A variety of programs intended for implementation after 1995 are identified that will employ new techniques for the investigation of outstanding scientific questions, will address new questions that arise as natural extensions of previous studies, and will allow the pursuit of new topics that cannot be addressed at present. The developments in technology that will be required for the era after 1995 are also described. The technology needs are summarized.
Author

N89-15854*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
MAX 1991: FLARE RESEARCH AT THE NEXT SOLAR MAXIMUM. WORKSHOP 1: SCIENTIFIC OBJECTIVES
Richard C. Canfield (Hawaii Univ., Honolulu.) and Brian R. Dennis Nov. 1988 316 p Workshop held in Kansas City, MO, 9-10 Jun. 1988
(NASA-TM-101259; NAS 1.15:101259) Avail: NTIS HC A14/MF A01 CSCL 03B

The purpose of the Max 1991 program is to gather coordinated sets of solar flare and active region data and to perform interpretive and theoretical research aimed at understanding flare energy storage and release, particle acceleration, flare energy transport, and the propagation of flare effects to Earth. The workshop was divided into four areas of concern: energy storage, energy release, particle acceleration, and energy transport. For individual titles, see N89-15855 through N89-15880.

N89-15855*# Lockheed Missiles and Space Co., Palo Alto, CA. Solar and Optical Physics.
ACTIVE REGION EVOLUTION IN THE CHROMOSPHERE AND TRANSTITION REGION
R. A. Shine and C. J. Schrijver (Joint Inst. for Lab. Astrophysics, Boulder, CO.) *In* NASA, Goddard Space Flight Center, Max 1991: Flare Research at the Next Solar Maximum. Workshop 1: Scientific Objectives Nov. 1988 p 29-32 (For primary document see N89-15854 07-92)
Avail: NTIS HC A14/MF A01 CSCL 03B

Images in the C IV 1548 A and the Si II 1526 Å lines taken with the ultraviolet spectrometer polarimeter (UVSP) instrument on board the Solar Maximum Mission (SMM) satellite were combined into movies showing the evolution of active regions and the neighboring supergranulation over several days. The data sets generally consist of 240 by 240 arc second rasters with 3 arc second pixels taken one per orbit (about every 90 minutes). The images are projected on a latitude/longitude grid to remove the forshortening as the region rotates across the solar disk and further processed to remove jitter and gain variations. Movies were made with and without differential rotation. Although there are occasional missing orbits, these series do not suffer from the long nighttime gaps that occur in observations taken at a single groundbased observatory and are excellent for studying changes on time scales of several hours. The longest sequence processed to date runs from 20 Oct. 1980 to 25 Oct. 1980. This was taken during an SMM flare buildup study on AR 2744. Several shorter sequences taken in 1980 and 1984 will also be shown. The results will be presented on a video disk which can be interactively controlled to view the movies.
Author

N89-15856*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
FULL-DISK MAGNETOGRAMS OBTAINED WITH A Na MAGNETO-OPTICAL FILTER AT THE MOUNT WILSON OBSERVATORY
Edward J. Rhodes, Jr., Alessandro Cacciani, Glenn Garneau, Tony Misch, Dusan Progovac, Tom Shieber, Steve Tomczyk, and Roger K. Ulrich (California Univ., Los Angeles.) *In* NASA, Goddard Space Flight Center, Max 1991: Flare Research at the Next Solar Maximum. Workshop 1: Scientific Objectives Nov. 1988 p 33-49 (For primary document see N89-15854 07-92)
(Contract NASw-13; NSF INT-84-00213)
Avail: NTIS HC A14/MF A01 CSCL 03B

The first full-disk magnetograms to be obtained with the Na magneto-optical filter (MOF) which is located at the 60 foot solar tower of the Mount Wilson Observatory are presented. This MOF was employed as a longitudinal magnetograph on June 18, 19, and July 1, 1987. On those three days the MOF was combined with a large format (1024 x 1024 pixel) virtual phase change coupled device camera and a high-speed data acquisition system. The combined system was used to record both line-of-sight magnetograms and Dopplergrams which covered the entire visible solar hemisphere. The pixel size of these magnetograms and Dopplergrams was 2.3 arcseconds. On each of the three days a time series of nine pairs of magnetograms and Dopplergrams was obtained at the rate of one pair every two minutes. On the same three day longitudinal magnetograms have one arcsecond pixels were obtained with the vacuum telescope at Kitt Peak. The MOF and vacuum tower magnetograms were compared at both the JPL Multi-Mission Image Processing Laboratory and at USC and have found the two sets of images to be well correlated both in spatial distribution and strength of the measured magnetic field. The simultaneously-obtained MOF Dopplergrams to remove the crosstalk which was present between the Doppler and Zeeman shifts of the NaD lines from the magnetograms from all three days and will also describe recent improvements to the system which allowed the obtaining of full-disk magnetograms as rapidly as one every 25 seconds.
Author

N89-15857*# Lockheed Missiles and Space Co., Palo Alto, CA.
OBSERVATIONS OF PHOTOSPHERIC MAGNETIC FIELDS AND SHEAR FLOWS IN FLARING ACTIVE REGIONS
T. Tarbell, S. Ferguson, Z. Frank, A. Title, and K. Topka *In* NASA, Goddard Space Flight Center, Max 1991: Flare Research at the Next Solar Maximum. Workshop 1: Scientific Objectives Nov. 1988 p 50-60 (For primary document see N89-15854 07-92)
(Contracts NAS8-32805; NAS5-26813)
Avail: NTIS HC A14/MF A01 CSCL 03B

Horizontal flows in the photosphere and subsurface convection zone move the footpoints of coronal magnetic field lines. Magnetic energy to power flares can be stored in the corona if the flows drive the fields far from the potential configuration. Videodisk movies were shown with 0.5 to 1 arcsecond resolution of the following simultaneous observations: green continuum, longitudinal magnetogram, Fe I 5576 A line center (mid-photosphere), H alpha wings, and H alpha line center. The movies show a 90 x 90 arcsecond field of view of an active region at S29, W11. When viewed at speeds of a few thousand times real-time, the photospheric movies clearly show the active region fields being distorted by a remarkable combination of systematic flows and small eruptions of new flux. Magnetic bipoles are emerging over a large area, and the polarities are systematically flowing apart. The horizontal flows were mapped in detail from the continuum movies, and these may be used to predict the future evolution of the region. The horizontal flows are not discernable in H alpha. The H alpha movies strongly suggest reconnection processes in the fibrils joining opposite polarities. When viewed in combination with the magnetic movies, the cause for this evolution is apparent: opposite polarity fields collide and partially cancel, and the fibrils reconnect above the surface. This type of reconnection, driven by subphotospheric flows, complicates the chromospheric and coronal fields, causing visible braiding and twisting of the fibrils. Some of the transient emission events in the fibrils and adjacent plage may also be related.
Author

N89-15858*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
FLARE ONSET AT SITES OF MAXIMUM MAGNETIC SHEAR
M. J. Hagyard and J. B. Smith, Jr. *In* NASA, Goddard Space Flight Center, Max 1991: Flare Research at the Next Solar Maximum. Workshop 1: Scientific Objectives Nov. 1988 p 61-80 (For primary document see N89-15854 07-92)
Avail: NTIS HC A14/MF A01 CSCL 03B

Observations of the transverse component of the Sun's photospheric magnetic field obtained with the MSFC vector magnetograph show where the fields are nonpotential. The correlation was studied between locations of nonpotential fields

and sites of flare onset for four different active regions. The details of the active region AR 4711 are outlined. Similar results are presented for three other regions: AR 2372 (April 1980), AR 2776 (November 1980), and AR 4474 (April 1984). For all four regions it is shown that flares initiate at sites on the magnetic neutral line where the local field deviates the most from the potential field. The results of this study suggest that flares are likely to erupt where the shear is equal to or greater than 85 degrees, the field is equal to or greater than 10000 G, and there is strong shear (equal to or greater then 80 degress) extending over a length equal to or greater than 8000 km. Author

N89-15859*# Hawaii Univ., Honolulu. Inst. for Astronomy.
AN IMAGING VECTOR MAGNETOGRAPH FOR THE NEXT SOLAR MAXIMUM
Richard C. Canfield and Donald L. Mickey *In* NASA, Goddard Space Flight Center, Max 1991: Flare Research at the Next Solar Maximum. Workshop 1: Scientific Objectives Nov. 1988 p 81-85 (For primary document see N89-15854 07-92)
Avail: NTIS HC A14/MF A01 CSCL 03B

Measurements of the vector magnetic field in the solar atmosphere with high spatial and temporal resolution over a large field of view are critical to understanding the nature and evolution of currents in active regions. Such measurements, when combined with the thermal and nonthermal X-ray images from the upcoming Solar-A mission, will reveal the large-scale relationship between these currents and sites of heating and particle acceleration in flaring coronal magnetic flux tubes. The conceptual design of an imaging vector magnetograph that combines a modest solar telescope with a rotating quarter-wave plate, an acousto-optical tunable prefilter as a blocker for a servo-controlled Fabry-Perot etalon, CCD cameras, and a rapid digital tape recorder are described. Its high spatial resolution (1/2 arcsec pixel size) over a large field of view (4 x 5 arcmin) will be sufficient to significantly measure, for the first time, the magnetic energy dissipated in major solar flares. Its millisecond tunability and wide spectra range (5000 to 8000 A) enable nearly simultaneous vector magnetic field measurements in the gas-pressure-dominated photosphere and magnetically dominated chromosphere, as well as effective co-alignment with Solar-A's X-ray images. Author

N89-15860*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
DEVELOPMENT OF THE SAMEX VECTOR MAGNETOGRAPH AT THE MARSHALL SPACE FLIGHT CENTER
E. A. West, M. J. Hagyard, G. A. Gary, and G. M. Arnett (BGB, Inc., Huntsville, AL.) *In* NASA, Goddard Space Flight Center, Max 1991: Flare Research at the Next Solar Maximum. Workshop 1: Scientific Objectives Nov. 1988 p 86-96 (For primary document see N89-15854 07-92)
Avail: NTIS HC A14/MF A01 CSCL 03B

A breadboard design to prove the operational feasibility of SAMEX Vector Magnetograph is being developed. Although the breadboard design will not include all of the elements of the original design concept, critical elements such as the large detector array and the high resolution polarimeter will be important parts of the breadboard design to study the data analysis and compression techniques that will be needed in a SAMEX instrument, to study the calibration techniques for systemmatic errors in the polarimeter, and to obtain high resolution vector magnetograms during the next solar maximum. Although the SAMEX polarimeter is not optimum for a ground-based patrol instrument, the design concept can be confirmed with ground-based measurements and direct comparisons with the existing vector magnetograph. The extension of the scientific objectives for this breadboard design is possible if a tunable filter can be acquired. Author

N89-15861*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
THE DRIVER IN FLARES AND CORONAL MASS EJECTIONS: MAGNETIC EXPANSION Abstract Only
Ronald L. Moore *In* NASA, Goddard Space Flight Center, Max 1991: Flare Research at the Next Solar Maximum. Workshop 1: Scientific Objectives Nov. 1988 p 97 Sponsored in part by Air Force (For primary document see N89-15854 07-92)
Avail: NTIS HC A14/MF A01 CSCL 03B

Chromospheric filaments, and hence the sheared magnetic fields that they trace, are observed to erupt in flares and coronal mass ejections. In the eruption, the filament-traced field is seen to expand in volume. For frozen-in magnetic field and isotropic expansion, the magnetic energy in a flux tube decreases as the flux tube expands. The amount of expansion of the magnetic field and the corresponding decrease in magnetic energy in a filament-eruption flare and/or coronal mass ejection can be estimated to order of magnitude from the observed expansion of the erupting filament. This evaluation for filament-eruption events in which the filament expansion is clearly displayed gives decreases in magnetic energy of the order of the total energy of the accompanying flare and/or coronal mass ejection. This simple expanding flux tube model can also fit the observed acceleration of coronal mass ejections, if it is assumed that the increase in mechanical energy of the mass ejection comes from the magnetic energy decrease in the expansion. These results encourage the view that magnetic expansion such as seen in filament eruptions drives both the plasma particle energization in flares and the bulk mass motion in coronal mass ejections. Author

N89-15862*# California Inst. of Tech., Pasadena.
PLANNED IMPROVEMENTS TO THE OWENS VALLEY FREQUENCY-AGILE INTERFEROMETER
Gordon J. Hurford and D. E. Gary *In* NASA, Goddard Space Flight Center, Max 1991: Flare Research at the Next Solar Maximum. Workshop 1: Scientific Objectives Nov. 1988 p 98-106 (For primary document see N89-15854 07-92)
Avail: NTIS HC A14/MF A01 CSCL 03B

Three small antennas will be added to the OVRO interferometer to form a five-element solar-dedicated array. This would provide up to 7 or 10 baselines (compared to the present 1 or 3). This would be sufficient to apply microwave diagnostics to most active region and burst sources. By using frequency-synthesis it would also provide an imaging capability comparable to that of an approximately 100 baseline interferometer. Expansion of the array is discussed. B.G.

N89-15863*# Maryland Univ., College Park.
MILLIMETER WAVELENGTH OBSERVATIONS OF SOLAR FLARES FOR MAX 1991
M. R. Kundu, N. Gopalswamy, N. Nitta, E. J. Schmahl, S. M. White, and W. J. Welch (California Univ., Berkeley.) *In* NASA, Goddard Space Flight Center, Max 1991: Flare Research at the Next Solar Maximum. Workshop 1: Scientific Objectives Nov. 1988 p 107-112 (For primary document see N89-15854 07-92)
Avail: NTIS HC A14/MF A01 CSCL 03B

The Hat Creek millimeter-wave interferometer (to be known as the Berkeley-Illinois-Maryland Array, BIMA) is being upgraded. The improved array will become available during the coming solar maximum, and will have guaranteed time for solar observing. The Hat Creek millimeter-wave interferometer is described along with the improvements. The scientific objectives are briefly discussed. B.G.

N89-15864*# Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
SOLAR VECTOR MAGNETOGRAPH FOR MAX 1991 PROGRAMS
D. M. Rust, J. W. OByrne, and T. J. Harris *In* NASA, Goddard Space Flight Center, Max 1991: Flare Research at the Next Solar Maximum. Workshop 1: Scientific Objectives Nov. 1988 p 113-120 (For primary document see N89-15854 07-92)
(Grant AF-AFOSR-0077-87)
Avail: NTIS HC A14/MF A01 CSCL 03B

An instrument for measuring solar magnetic fields is under construction. Key requirements for any solar vector magnetograph are high spatial resolution, high optical throughput, fine spectral selectivity, and ultralow instrumental polarization. An available 25

cm Cassegrain telescope will provide 0.5 arcsec spatial resolution. Spectral selection will be accomplished with a 150 mA filter based on electrically tunable solid Fabry-Perot etalon. Filter and polarization analyzer design concepts for the magnetograph are described in detail. The instrument will be tested at JHU/APL, and then moved to the National Solar Observatory in late 1988. It will be available to support the Max 1991 program. Author

N89-15865*# California Univ., Irvine. Dept. of Physics.
MECHANISMS FOR FAST FLARE RECONNECTION
G. VanHoven, D. Deeds, and T. Tachi *In* NASA, Goddard Space Flight Center, Max 1991: Flare Research at the Next Solar Maximum. Workshop 1: Scientific Objectives Nov. 1988 p 121-131 Sponsored in part by NSF (For primary document see N89-15854 07-92)
Avail: NTIS HC A14/MF A01 CSCL 03B

Normal collisional-resistivity mechanisms of magnetic reconnection have the drawback that they are too slow to explain the fast rise of solar flares. Two methods are examined which are proposed for the speed-up of the magnetic tearing instability: the anomalous enhancement of resistivity by the injection of MHD turbulence and the increase of Coulomb resistivity by radiative cooling. The results are described for nonlinear numerical simulations of these processes which show that the first does not provide the claimed effects, while the second yields impressive rates of reconnection, but low saturated energy outputs. Author

N89-15866*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
ARCHES SHOWING UV FLARING ACTIVITY
J. M. Fontenla *In* NASA, Goddard Space Flight Center, Max 1991: Flare Research at the Next Solar Maximum. Workshop 1: Scientific Objectives Nov. 1988 p 141-144 (For primary document see N89-15854 07-92)
Avail: NTIS HC A14/MF A01 CSCL 03B

The UVSP data obtained in the previous maximum activity cycle show the frequent appearance of flaring events in the UV. In many cases these flaring events are characterized by at least two footpoints which show compact impulsive non-simultaneous brightenings and a fainter but clearly observed arch developes between the footpoints. These arches and footpoints are observed in line corresponding to different temperatures, as Lyman alpha, N V, and C IV, and when observed above the limb display large Doppler shifts at some stages. The size of the arches can be larger than 20 arcsec. Author

N89-15867*# Alabama Univ., Huntsville. Dept. of Physics.
THE NEED FOR HARD X-RAY IMAGING OBSERVATIONS AT THE NEXT SOLAR MAXIMUM
A. Gordon Emslie *In* NASA, Goddard Space Flight Center, Max 1991: Flare Research at the Next Solar Maximum. Workshop 1: Scientific Objectives Nov. 1988 p 145-152 (For primary document see N89-15854 07-92)
Avail: NTIS HC A14/MF A01 CSCL 03B

Canonical models of solar hard X-ray bursts; associated length and time scales; the adequacies and inadequacies of previous observations; theoretical modeling predictions; arcsecond imaging of solar hard X-rays are outlined. B.G.

N89-15868*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THE FOURIER IMAGING X-RAY SPECTROMETER (FIXS) FOR THE ARGENTINIAN, SCOUT-LAUNCHED SATELITE DE APLICACIONES CIENFICAS-1 (SAC-1)
Brian R. Dennis, Carol Jo Crannell, Upendra D. Desai, Larry E. Orwig, Alan L. Kiplinger, Richard A. Schwartz, Gordon J. Hurford, A. Gordon Emslie, Marcos Machado, and Kent Wood (Naval Research Lab., Washington, DC.) *In its* Max 1991: Flare Research at the Next Solar Maximum. Workshop 1: Scientific Objectives Nov. 1988 p 153-163 (For primary document see N89-15854 07-92)
Avail: NTIS HC A14/MF A01 CSCL 03B

The Fourier Imaging X-ray Spectrometer (FIXS) is one of four instruments on SAC-1, the Argentinian satellite being proposed for launch by NASA on a Scout rocket in 1992/3. The FIXS is designed to provide solar flare images at X-ray energies between 5 and 35 keV. Observations will be made on arcsecond size scales and subsecond time scales of the processes that modify the electron spectrum and the thermal distribution in flaring magnetic structures. Author

N89-15869*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
IMAGING SOLAR FLARES IN HARD X-RAYS AND GAMMA RAYSFROM BALLOON-BORNE PLATFORMS
Carol Jo Crannell *In its* Max 1991: Flare Research at the Next Solar Maximum. Workshop 1: Scientific Objectives Nov. 1988 p 164-176 (For primary document see N89-15854 07-92)
Avail: NTIS HC A14/MF A01 CSCL 03B

Hard X-rays and gamma rays carry the most direct evidence available for the roles of accelerated particles in solar flares. An approach that employs a spatial Fourier-transform technique for imaging the sources of these emissions is described and plans for developing a balloon-borne gamma ray imaging device (GRID) based on this instrumental approach is presented. This instrument, GRID on a balloon, would enable observations with a 1.6 arcsecond angular resolution, 10 millisecond time resolution, and whole-Sun field of view on long-duration balloon flights during MAX 1991. Author

N89-15870*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
HIGH-SPATIAL RESOLUTION AND HIGH-SPECTRAL RESOLUTION DETECTOR FOR USE IN THE MEASUREMENT OF SOLAR FLARE HARD X-RAYS
U. D. Desai and Larry E. Orwig *In its* Max 1991: Flare Research at the Next Solar Maximum. Workshop 1: Scientific Objectives Nov. 1988 p 177-192 (For primary document see N89-15854 07-92)
Avail: NTIS HC A14/MF A01 CSCL 03B

In the areas of high spatial resolution, the evaluation of a hard X-ray detector with 65 micron spatial resolution for operation in the energy range from 30 to 400 keV is proposed. The basic detector is a thick large-area scintillator faceplate, composed of a matrix of high-density scintillating glass fibers, attached to a proximity type image intensifier tube with a resistive-anode digital readout system. Such a detector, combined with a coded-aperture mask, would be ideal for use as a modest-sized hard X-ray imaging instrument up to X-ray energies as high as several hundred keV. As an integral part of this study it was also proposed that several techniques be critically evaluated for X-ray image coding which could be used with this detector. In the area of high spectral resolution, it is proposed to evaluate two different types of detectors for use as X-ray spectrometers for solar flares: planar silicon detectors and high-purity germanium detectors (HPGe). Instruments utilizing these high-spatial-resolution detectors for hard X-ray imaging measurements from 30 to 400 keV and high-spectral-resolution detectors for measurements over a similar energy range would be ideally suited for making crucial solar flare observations during the upcoming maximum in the solar cycle. Author

N89-15871*# New Hampshire Univ., Durham. Dept. of Physics.
A COSMIC AND SOLAR X-RAY AND GAMMA-RAY INSTRUMENT FOR A SCOUT LAUNCH
D. J. Forrest, W. T. Vestrand, and E. L. Chupp *In* NASA, Goddard Space Flight Center, Max 1991: Flare Research at the Next Solar Maximum. Workshop 1: Scientific Objectives Nov. 1988 p 193-200 (For primary document see N89-15854 07-92)
Avail: NTIS HC A14/MF A01 CSCL 03B

An overview is presented for a set of simple and robust X-ray and gamma ray instruments which have both cosmic and solar objectives. The primary solar scientific objective is the study of the beaming of energetic electrons and ions in solar flares. The instrument will measure spectra and polarization of flare emissions

up to 10 MeV. At X-ray energies both the directly emitted flux and the reflected albedo flux will be measured with a complement of six X-ray sensors. Each of these detectors will have a different high Z filter selected to optimize both the energy resolution and high rate capabilities in the energy band 10 to 300 keV. At energies greater than 100 keV seven 7.6 x 7.6 cm NaI and a set of 30 concentric plastic scattering detectors will record the spectra and polarization of electron bremsstrahlung and nuclear gamma rays. All of the components of the instrument are in existence and have passed flight tests for earlier space missions. The instrument will use a spinning solar oriented Scout spacecraft. The NaI detectors will act as a self-modulating gamma ray detector for cosmic sources in a broad angular band which lies at 90 degrees to the Sun-Earth vector and hence will scan the entire sky in 6 months. Author

N89-15872*# New Hampshire Univ., Durham. Space Science Center.

FLARE OBSERVATION DURING MAX 1991 BALLOON CAMPAIGNS

David J. Forrest *In* NASA, Goddard Space Flight Center, Max 1991: Flare Research at the Next Solar Maximum. Workshop 1: Scientific Objectives Nov. 1988 p 201-203 (For primary document see N89-15854 07-92)

Avail: NTIS HC A14/MF A01 CSCL 03B

A brief overview is presented for some of the large flare properties as observed during the prime SMM flare observation interval, 1980 to 1984. Two of these properties, namely their tendency to occur in groups and the strong effects of the 154 day periodicity, can be used to increase the probability of detecting large flares during the limited observing duration of Max 1991 balloon campaigns provided the solar flare characteristics of the 1991 solar cycle follows that observed in 1980 to 1984. Author

N89-15873*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

SOLAR RESPONSE OF THE BATSE INSTRUMENT ON THE GAMMA-RAY OBSERVATORY

G. J. Fishman, C. A. Meegan, T. A. Parnell, R. B. Wilson, W. Paciesas, T. Cline, B. Teegarden, B. Schaefer, Hugh Hudson, and J. L. Matteson (California Univ., San Diego, La Jolla.) *In* NASA, Goddard Space Flight Center, Max 1991: Flare Research at the Next Solar Maximum. Workshop 1: Scientific Objectives Nov. 1988 p 204-213 (For primary document see N89-15854 07-92)

(Contract NAS8-36081; NsG-7161)

Avail: NTIS HC A14/MF A01 CSCL 03B

The Burst and Transient Source Experiment (BATSE) on board the gamma ray observatory (GRO) aims at comprehensive observations of time profiles, spectra, and locations of high-energy transient sources. The mysterious cosmic gamma ray bursts provided the main motivation for the observations, but BATSE will make excellent observations of many classes of sources, and in particular solar flares. The solar response of BATSE, as inferred from its design parameters, is analyzed for two purposes: the optimization of the solar observations themselves, and the characterization of the solar effects on ordinary nonsolar observations. Author

N89-15874*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

DEVELOPMENT OF A HIGH-SPEED H-ALPHA CAMERA SYSTEM FOR THE OBSERVATION OF RAPID FLUCTUATIONS IN SOLAR FLARES

Alan L. Kiplinger, Brian R. Dennis, Larry E. Orwig, and P. C. Chen *In its* Max 1991: Flare Research at the Next Solar Maximum. Workshop 1: Scientific Objectives Nov. 1988 p 214-223 Prepared in cooperation with ST Systems Corp., Greenbelt, MD (For primary document see N89-15854 07-92)

Avail: NTIS HC A14/MF A01 CSCL 03B

A solid-state digital camera was developed for obtaining H alpha images of solar flares with 0.1 s time resolution. Beginning in the summer of 1988, this system will be operated in conjunction with SMM's hard X-ray burst spectrometer (HXRBS). Important electron time-of-flight effects that are crucial for determining the flare energy release processes should be detectable with these combined H alpha and hard X-ray observations. Charge-injection device (CID) cameras provide 128 x 128 pixel images simultaneously in the H alpha blue wing, line center, and red wing, or other wavelength of interest. The data recording system employs a microprocessor-controlled, electronic interface between each camera and a digital processor board that encodes the data into a serial bitstream for continuous recording by a standard video cassette recorder. Only a small fraction of the data will be permanently archived through utilization of a direct memory access interface onto a VAX-750 computer. In addition to correlations with hard X-ray data, observations from the high speed H alpha camera will also be correlated and optical and microwave data and data from future MAX 1991 campaigns. Whether the recorded optical flashes are simultaneous with X-ray peaks to within 0.1 s, are delayed by tenths of seconds or are even undetectable, the results will have implications on the validity of both thermal and nonthermal models of hard X-ray production. Author

N89-15875*# Texas Univ., Austin.

DOES THE RESISTIVE TEARING INSTABILITY NONLINEARLY EVOLVE TO A FAST RECONNECTION MODE

R. S. Steinolfson *In* NASA, Goddard Space Flight Center, Max 1991: Flare Research at the Next Solar Maximum. Workshop 1: Scientific Objectives Nov. 1988 p 224-245 Sposored in part by NSF (For primary document see N89-15854 07-92)

Avail: NTIS HC A14/MF A01 CSCL 03B

A fundamental problem in applying linear tearing instability theory to the rapid processes (particle acceleration, heating) in flares was the characteristically slow rate of reconnection. This problem can be at least partially overcome if the tearin mode nonlinearly evolves to a regime in which the reconnection rate is substantially enhanced, such as that for the Petschek configuration. This possibility was often suggested, and some numerical simulations appear to provide support for such a view. Numerical simulation are used to study the nonlinear evolution of the tearing stability and show that a fast Petschek-like regime may not be achieved. This conclusion follows when there are sufficient grid points within the diffusion region to completely resolve the nonlinear dynamic interactions in the diffusion layer. When the numerical resolution is not adequate, the solution does appear to approach a Petschek configuration. The resolved solution contains reverse flow vortices and current sheets, terminated with a current reversal, similar to those obtained by Syrovatsky (JEPT, 33, 933, 1971). Author

N89-15876*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

MODELLING A C-TYPE FLARE OBSERVED IN MICROWAVES AND HARD X-RAYS

E. J. Schmahl, M. R. Kundu (Maryland Univ., College Park.), and Brian R. Dennis *In its* Max 1991: Flare Research at the Next Solar Maximum. Workshop 1: Scientific Objectives Nov. 1988 p 246-261 (For primary document see N89-15854 07-92)

Avail: NTIS HC A14/MF A01 CSCL 03B

Using the very large array (VLA) at 6 and 20 cm wavelength and the hard X-ray burst spectrometer on the Solar Maximum Mission, a two-ribbon flare was observed from the onset phase through the maximum and decline on November 14, 1981. Because of the extensive size of the microwave source and the gradual variations in hard X-rays whose spectrum becomes progressively flatter with time, the flare is classified as a C-type flare. Considering the hardening of the X-ray spectrum and its non-impulsive nature, a coronal trap model was invoked for the energetic electrons. The microwave emission is easily accounted for by gyrosynchronous radiation from mildly relativistic electrons. It was found that the source must be optically thick at 20 cm during the maximum phase, but as the source evolved toward an optically thin regime, the intensity decreased while the degree of circular polarization increased. In an initial homogeneous model, we found that the computed microwave spectrum was too narrow to match

the patrol spectrum from 606 to 15400 MHz. In the model, the magnetic field consists of a dipolar arcade bridging the H alpha ribbons, and extending to heights of order 40,000 to 50,000 km. The variation of the magnetic field strength from footpoints to apex causes the gyrosynchrotron spectrum to be broader. Preliminary conclusions regarding the electron distributions producing the hard X-rays and the microwaves, and the suitability of this model for C-type flares is presented. Author

N89-15877*# California Univ., Berkeley. Space Sciences Lab.
A HIGH-RESOLUTION GAMMA-RAY AND HARD X-RAY SPECTROMETER FOR SOLAR FLARE OBSERVATIONS IN MAX 1991
R. P. Lin, D. W. Curtis, P. Harvey, K. Hurley, J. H. Primbsch, D. M. Smith, R. M. Pelling, and F. Duttweiler (California Univ., San Diego.) *In* NASA, Goddard Space Flight Center, Max 1991: Flare Research at the Next Solar Maximum. Workshop 1: Scientific Objectives Nov. 1988 p 262-278 (For primary document see N89-15854 07-92)
(Grants NAGw-516; NAGw-449)
Avail: NTIS HC A14/MF A01 CSCL 03B

A long duration balloon flight instrument for Max 1991 designed to study the acceleration of greater than 10 MeV ions and greater than 15 keV electrons in solar flares through high resolution spectroscopy of the gamma ray lines and hard X-ray and gamma ray continuum is described. The instrument, HIREGS, consists of an array of high-purity, n-type coaxial germanium detectors (HPGe) cooled to less than 90 K and surrounded by a bismuth germanate (BGO) anticoincidence shield. It will cover the energy range 15 keV to 20 MeV with keV spectral resolution, sufficient for accurate measurement of all parameters of the expected gamma ray lines with the exception of the neutron capture deuterium line. Electrical segmentation of the HPGe detector into a thin front segment and a thick rear segment, together with pulse-shape discrimination, provides optimal dynamic range and signal-to-background characteristics for flare measurements. Neutrons and gamma rays up to approximately 0.1 to 1 GeV can be detected and identified with the combination of the HPGe detectors and rear BGO shield. The HIREGS is planned for long duration balloon flights (LDBF) for solar flare studies during Max 1991. The two exploratory LDBFs carried out at mid-latitudes in 1987 to 1988 are described, and the LDBFs in Antarctica, which could in principle provide 24 hour/day solar coverage and very long flight durations (20 to 30 days) because of minimal ballast requirements are discussed.
Author

N89-15878*# California Inst. of Tech., Pasadena.
COORDINATED VIDEOMAGNETOGRAPH OBSERVATIONS BY THE BIG BEAR AND HUAIROU OBSERVATORIES
Haimin Wang, Alan Patterson, Harold Zirin, Guoxiang Ai, and Hongqi Zhang (Beijing Observatory, Huairou, China) *In* NASA, Goddard Space Flight Center, Max 1991: Flare Research at the Next Solar Maximum. Workshop 1: Scientific Objectives Nov. 1988 p 279-282 (For primary document see N89-15854 07-92)
Avail: NTIS HC A14/MF A01 CSCL 03B

A videomagnetograph patterned after the BBSO system was installed at Huairou in 1987, and five days of coordinated observing were carried out from September 24 to 29, 1987. The data were combined to make a continuous movie of the fields abound a stable spot. A 57 hour magnetograph run with two seven hour gaps were achieved from 2330 UT, September 24 to 0830 UT, September 27. The frames were reregistered and justified to eliminate the change of scale with meridian distance. The intensities were corrected for cosine effect. Preliminary examination of the data shows continuous decrease of the total magnetic field during this period by more than 50 percent. The principal loss of flux appears to be due to cancellation at the main neutral line. Some flux disappears due to fragmentation, which makes the elements fall below the threshold, while only a tiny loss due to diffusion can be detected. It is planned to continue this program during Max 1991, including transverse field measurements as well. Several long runs were already obtained in 1988. Author

N89-15879*# Lockheed Missiles and Space Co., Palo Alto, CA.
HIGH-RESOLUTION DIGITAL MOVIES OF EMERGING FLUX AND HORIZONTAL FLOWS IN ACTIVE REGIONS ON THE SUN
K. Topka, S. Ferguson, Z. Frank, T. Tarbell, and A. Title *In* NASA, Goddard Space Flight Center, Max 1991: Flare Research at the Next Solar Maximum. Workshop 1: Scientific Objectives Nov. 1988 p 283-293 (For primary document see N89-15854 07-92)
(Contracts NAS8-32805; NAS5-26813)
Avail: NTIS HC A14/MF A01 CSCL 03B

High-resolution observations of active regions in many wavelength bands obtained at the Vacuum Tower Telescope of NSO/Sunspot (Sacramento Peak) are presented. The SOUP tunable filter, HRSO 1024 x 1024 CCD camera, and a sunspot tracker for image stabilization were used. Subarrays of 512 x 512 pixels were processed digitally and recorded on videodisk in movie format. The movies with 0.5 to 1 arcsecond resolution of the following simultaneous observations were shown: green continuum, longitudinal magnetogram, Doppler velocity, Fe I 5576 A line center, H alpha wings, and H alpha line center. The best set of movies show a 90 x 90 arcsecond field-of-view of an active region at S29, W11. When viewed at speeds of a few thousand times real-time, the photospheric movies clearly show the active region fields being distorted by a remarkable combination of systematic flows and small eruptions of new flux. Flux emergence is most easily discovered in line center movies: an elongated dark feature appears first, followed soon after by bright points at one or both ends. A brief, strong upflow is seen when the dark feature first appears; downflow in the bright points persists much longer. The magnetic flux appears to increase gradually over this extended period. Some of the flux emergence events were studied in detail, with measurements of horizontal and vertical velocities and magnetic flux versus time within one footpoint of the loop.
Author

N89-15880*# Lockheed Missiles and Space Co., Palo Alto, CA.
STATISTICAL PROPERTIES OF SOLAR GRANULATION FROM THE SOUP INSTRUMENT ON SPACELAB 2
K. Topka, A. Title, T. Tarbell, S. Ferguson, and R. Shine *In* NASA, Goddard Space Flight Center, Max 1991: Flare Research at the Next Solar Maximum. Workshop 1: Scientific Objectives Nov. 1988 p 294-307 (For primary document see N89-15854 07-92)
Avail: NTIS HC A14/MF A01 CSCL 03B

The Solar Optical Universal Polarimeter (SOUP) on Spacelab 2 collected movies of solar granulation completely free from atmospheric blurring, and are not degraded by pointint jitter (the pointing stability was 0.003 sec root mean square). The movies illustrate that the solar five minute oscillation has a major role in the appearance of solar granulation and that exploding granules are a common feature of the granule evolution. Using 3-D Fourier filtering techniques the oscillations were removed and it was demonstrated that the autocorrelation lifetime of granulation is a factor of two greater in magnetic field regions than in field-free quiet sun. Horizontal velocities were measured and flow patterns were observed on the scale of meso- and super granulation. In quiet regions the mean flow velocity is 370 m/s while in the magnetic regions it is about 125 m/s. It was also found that the root mean square (RMS) fluctuating horizonal velocity field is substantially greater in quiet sun than in strong magnetic field regions. By superimposing the location of exploding granules on the average flow maps it was found that they appear almost exclusively in the center of mesogranulation size flow cells. Because of the nonuniformity of the distribution of exploding granules, the evolution of the granulation pattern in mesogranule cell centers and boundaries differs fundamentally. It is clear from this study there is neither a typical granule nor a typical granule evolution. Author

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N89-15881 Maryland Univ., College Park.
EXTENDED OPTICAL EMISSION LINE GAS IN POWERFUL RADIO GALAXIES Ph.D. Thesis
Stefi Alison Baum 1987 339 p
Avail: Univ. Microfilms Order No. DA8808525

The results are presented of a search for extended optical emission line gas in 43 powerful radio galaxies. Spatially extended optical emission line gas is common in these galaxies. The extent and luminosity of the emission line gas in powerful radio galaxies is an order of magnitude greater than in normal elliptical galaxies of similar optical magnitudes. The total emission line luminosity is roughly half of the radio luminosity and the radio luminosity correlates with the narrow line luminosity over four decades. The near nuclear emission line gas is often distributed in a smooth, roughly elliptical feature, centered on and symmetric about the nucleus. The distribution of axial ratios found in these small emission line nebulae is inconsistent with them being disks seen from different orientations. The minor axes of the small regions of emission line gas show only a weak tendency to align with the position angle of the extended radio source and the major axis of the stellar isophotes. Dissert. Abstr.

N89-15882 Wisconsin Univ., Madison.
OBSERVATIONS OF THE DIFFUSE X-RAY BACKGROUND BELOW 0.2 keV AND CONSTRAINTS ON SIMPLE MODELS FOR ITS SPATIAL DISTRIBUTION Ph.D. Thesis
Michael Juda 1988 143 p
Avail: Univ. Microfilms Order No. DA8801480

Observations of the soft X-ray diffuse background from a sounding rocket flight are presented. Counting rates are given to two broad energy bands, the Be band and the B' band, for nine 15 deg x 15 deg FWHM fields of view in the general direction of the galactic anticenter. The total neutral hydrogen column density in the observed directions ranged from 1.2 x 10 to the 20th to 48 x 10 to the 20/sq cm. The counting rates in the two X-ray bands anticorrelate with the total HI column density. A simple model which provides the observed anticorrelation between the X-ray counting rate and total HI column density through absorption has two isotropic X-ray emission sources. One source is in front of all the neutral gas and provides a constant contribution to the counting rate in all directions. An alternative model for the relative distribution of X-ray emitting and absorbing material has an irregularly shaped region filled with hot, low density gas producing all the soft X-rays. The observed rate in a given direction depends on the distance to the edge of the emitting region. The X-ray emitting region forms a cavity in the neutral gas. Dissert. Abstr.

N89-15883 Wisconsin Univ., Madison.
A SEARCH FOR VERY HIGH ENERGY GAMMA RAYS FROM HERCULES X-1 Ph.D. Thesis
Patrick Olson Slane 1988 213 p
Avail: Univ. Microfilms Order No. 8809052

The Haleakala Gamma Ray Telescope is used to detect Extensive Air Showers by utilizing the Atmospheric Cerenkov Technique. The resulting data are analyzed in an effort to detect the presence of gamma-ray initiated showers above a threshold energy of approximately 200 GeV. Hercules X-1, a neutron star member of an accretion-powered X-ray binary system, was observed for 104 hours in May through July 1986. On May 14 a burst of activity of approximately 15 minutes duration was detected. Although this period differs significantly from the pulsar period expected from X-ray observations, it is consistent with measurements of the periodicity of VHE and UHE gamma-rays by other observers during the summer of 1986. This surprising result indicates that the gamma-ray production mechanism operates in a region well removed from the neutron star and may set constraints on models involving the interaction of the accretion disk with the magnetosphere associated with the neutron star. Dissert. Abstr.

N89-15884*# Stanford Univ., CA. Center for Space Science and Astrophysics.
DIRECTIONALITY OF CONTINUUM GAMMA RAYS FROM SOLAR FLARES
Taeil Bai Apr. 1988 19 p Previously announced in IAA as A89-16690
(Contract NAS8-37334; NGL-05-020-272; N00014-85-K-0111)
(NASA-CR-184661; NAS 1.26:184661; AD-A199379; CSSA-ASTRO-88-02) Avail: NTIS HC A03/MF A01 CSCL 03B

The hard X-ray spectrometer total counts are used as calibration to investigate how the brightness of gamma rays above 300 keV changes as a function of the heliocentric angle of a flare. The normalized gamma-ray brightness, on the average, increases with the heliocentric angle; a flare at the limb is estimated to be 13 times brighter in gamma-rays than a similar flare near the central meridian. Both pancake-like electron distributions and downward beam distributions can be adjusted to produce the deduced limb brightening. GRA

N89-15885# Consiglio Nazionale delle Ricerche, Frascati (Italy). Istituto di Fisica dello Spazio Interplanetario.
SHORT-TERM COSMIC RAY INCREASES AND MAGNETIC CLOUD-LIKE STRUCTURES DURING FORBUSH DECREASES
N. Iucci, M. Parisi, C. Signorini, M. Storini, and G. Villoresi (La Sapienza Univ., Rome, Italy) Jul. 1988 63 p Presented at the 11th European Cosmic Ray Symposium, Balatonfured, Hungary
(IFSI-88-9; ETN-89-93476) Avail: NTIS HC A04/MF A01

Clear short-term cosmic ray increases with the time duration between 5 to 30 hours were identified by analyzing the nucleonic intensity recorded during Forbush decreases (amplitude greater than 1.5 percent at high-latitude stations), occurring in the period 1966-1979. The increases begin from 4 to 30 hr after the interplanetary shock arrival, and take place during the passage at the Earth of singular solar wind structures, characterized by cold material, intense magnetic-field strength and regular changes and regular changes in the B direction. The occurrences seem to be an indicator of the passage at the Earth of a magnetic cloud-like structure associated with flare ejecta material. ESA

N89-15817*# New Mexico Univ., Albuquerque. Dept. of Physics and Astronomy.
COSMIC-RAY DETECTORS ON THE MOON
John Linsley *In* NASA, Lyndon B. Johnson Space Center, Future Astronomical Observatories on the Moon Mar. 1988 p 55-62 (For primary document see N89-15810 07-89)
Avail: NTIS HC A07/MF A01 CSCL 03B

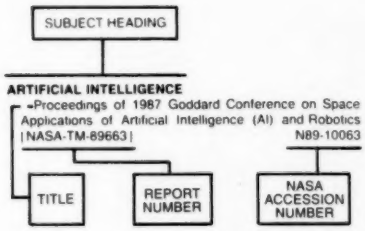
99 GENERAL

N89-15886*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
RESEARCH AND TECHNOLOGY 1988 Annual Report
Dec. 1988 205 p Original contains color illustrations
(NASA-TM-4078; L-16518; NAS 1.15:4078) Avail: NTIS HC A10/MF A01 CSCL 05D

The mission of the NASA Langley Research Center is to increase the knowledge and capability of the United States in a full range of aeronautics disciplines and in selected space disciplines. The mission will be accomplished by performing innovative research relevant to national needs and Agency goals, transferring technology to users in a timely manner, and providing development support to other U.S. Government agencies, industry, and other NASA Centers. This report contains highlights of the major accomplishments and applications made during the past

year. The highlights illustrate both the broad range of the research and technology activities at NASA Langley and the contributions of this work toward maintaining U.S. leadership in aeronautics and space research. Author

Typical Subject Index Listing



The subject heading is the key to the subject content of the document. Titles, report numbers, and accession numbers of pertinent documents are provided under each subject heading. When the title is insufficiently descriptive of the document content, a title extension has been added, separated from the title by three hyphens. The report number helps to indicate the type of document cited (e.g., NASA report, NASA translation, NASA contractor report). The NASA accession number is the number by which the document abstracts are arranged in this journal and by which the document is sold or requested. The titles, with title extensions if present, are arranged under each subject heading in ascending accession number order. The subject headings have been selected from the latest revision of the *NASA Thesaurus* (NASA SP-7064).

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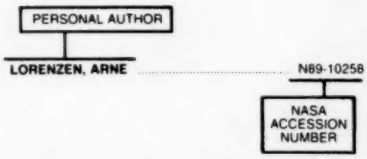

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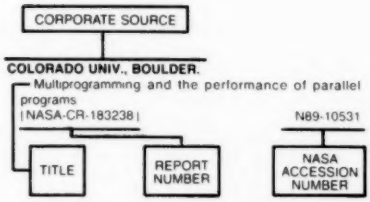

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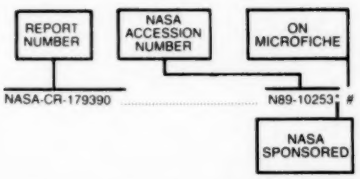

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UTRC/R88-927258 ..... N89-15711 #

UTSI-88-06 ..... N89-15079 #

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Austin, TX 78711
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